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The Metabolism of Nitrogen in Man

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THE METABOLISM OF NITROGEN IN MAN

BY

AUGUST FRANK DANIEL WUSSOW

THESIS FOR THE DEGREE OF BACHELOR OF SCIENCE

IN CHEMISTRY

IN THE

COLLEGE OF SCIENCE

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

August Frank Daniel Wasson.

ENTITLED The Metabolism of Nitrogen in Man.

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor in Chemistry

H. S. Grindley. Instructor in Charge.

APPROVED: Wm A. Noyes

HEAD OF DEPARTMENT OF Chemistry.

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THE METABOLISM OF NITROGEN IN MAN.

Of all the elements considered in metabolism experiments, nitrogen appears to be the one upon which most work has been done. Since the end products of protein or nitrogen metabolism are excreted almost entirely in the urine, they can be readily collected and prepared for analysis. The development of the Kjeldahl method for the determination of nitrogen made the study of nitrogen metabolism an easy and rapid one to follow. In addition to these reasons, the great importance attached by earlier investigators to protein as a food, the belief that it was of more importance to the body than both fat and carbohydrates account, in part, for the enormous amount of work that has been done upon the subject of the metabolism of nitrogen, in man and in other animals. Regarding man alone, the subject has been considered from many sides; man under normal conditions and abnormal conditions, in health and in disease. The subject has been studied in relation to certain diets or the value of certain substances as articles of diet; to determine the influences of drugs and preservatives, of muscular work, of inanition and other conditions of life or environment. It is the purpose of this paper to consider only those experiments and that work which deal with man under normal conditions; that is, normal health and normal diet. Reference to other works will

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be made only as it applies to the subject limited in this way.

BIBLIOGRAPHY AND REVIEW.

1. Atwater and Langworthy:

A Digest of Metabolism Experiments.

Bulletin 45, Office of Experiment Station, U. S. Department of Agriculture, Washington, 1897.

A digest of metabolism experiments in which the balance of income and outgo was determined. The most important and complete experiments up to 1894, and a few after that year, are included. The experiments abstracted include those with man and animals. They are carefully classified; e.g., those dealing with man—healthy subjects—are arranged in groups as follows:

A. Healthy subjects, influence of diet:

(1) vegetarian diet, (2) milk diet, (3) bread and other single food materials, (4) alcoholic beverage added to diet, (5) peptones and similar preparations added to diet, (6) to determine amount of protein required, (7) miscellaneous experiments on the influence of diet.

B. Healthy subjects, influence of other conditions than diet:

(1) fasting, (2) drugs, (3) muscular exertion and the excretion of nitrogen, (4) massage and faradization, (5) baths and enemas, (6) influence of pregnancy and childbirth, (7) menstruation, (8) copious and diminished water drinking, (9) subjects breathed compressed air.

The data are tabulated and are supplemented in the text by discussions of the purposes, methods, conditions and conclusions of the experiments. In all, 2299 individual tests or averages, made with man, are abstracted.

2. R. O. Neuman:

Experimentelle Beiträge zur Lehre von dem täglichen Nahrungsbedarf des Menschen unter besonderer Berücksichtigung der Notwendigen Eiweissmenge.

Archiv. f. Hygiene, Band 45, p. 1, 1902.

This article consists of "experimental contributions to the study of the daily food requirement of man, with special reference to the necessary amount of protein", and a bibliography and review of the most important metabolism experiments which refer to the subject up to the year 1902.

The experiments reported were conducted by the author upon himself, through a total of 746 days. The experiment was divided into three periods of 10 months, 50 days, and 8 months each. The periods were not consecutive, and really constituted three separate experiments. In the longer periods, only the food was measured and analysed, and not even all the articles of the diet were analysed by the author himself. For the values of some he depended upon results taken from previous investigations. To the amounts of protein, carbohydrates and fats thus found to be ingested, he applied the ratios of absorption or digestibility previously determined by other investigators and determined the metabolism of the various nutrients. The diet consisted of meats, and smaller quantities of bread and vegetables, and in the 10

months period contained considerable quantities of beer (1000 to 1500 c c per day); in the 8 months period, the amount of beer was much smaller (about 150 c c per day). Calculated for a body weight of 70 kilos, the diet contained during the first period, 66.1 grams protein, 83.5 grams fat, 230 grams carbohydrates and 43.7 alcohol. The fuel value amounted to 2199 calories. The body weight increased slightly. During the third period, the diet contained 74 grams protein, 106.1 grams fat, 164.2 grams carbohydrates, 5.3 grams alcohol and was equivalent to 1999 calories.

The second period constituted a complete metabolism experiment of 50 days. All food, and all excreta, were carefully analysed. The experiment was begun with a diet low in protein (51.3 grams). This was found insufficient to keep the body in nitrogen equilibrium. The proportion of protein, fat, and carbohydrates was varied as the experiment progressed until the diet was found which was sufficient to maintain nitrogen equilibrium. During the last 15 days equilibrium was established with 76.5 grams protein, 155.7 fat, and 220 grams carbohydrates, the fuel value being 2658.7 calories, (daily average).

In the bibliography and review of previous works, 307 experiments with families and individuals are considered. The data are tabulated and also discussed, and are calculated for a uniform body weight of 70 kilos for intelligent comparison.

Conclusions:

1. The tabulated uniform results collected from the literature show that in 307 experiments with families and individuals in—

181 cases the Voit standard of 118 grams of protein was not reached.
126 cases the Voit standard of 118 grams of protein was exceeded.

(2) Body weight was maintained in his own experiments on diets containing less than the Voit standard. Moreover, three distinct rations containing different amounts of food stuffs were used at different times.

3. Wiley, H. W.; Bigelow, W. D.; Weber, F. C.; and others.

Influence of Food Preservatives and Artificial Colors on Digestion and Health.

Bulletin No. 84, U. S. Department of Agriculture, Bureau of Chemistry, Washington, D. C., 1904.

Part I.- Boric Acid and Borax:

This is a report of the investigations conducted by Dr. Wiley at Washington to determine the effects of boric acid and borax on digestion and health. The subjects of the experiment were twelve men (civil service employes). The time of the experiment, seven months, was divided into six series. Series 1 to 5, lasted one month each; series 6, two months. Each series consisted of a fore-, preservative-, and after-period. The preservative was administered in increasing amounts except in the last series, during which ½ gram was given. Food, feces, and urine were analysed and the nitrogen balance determined.

The averages, taken from the general summary of nitrogen balance tables (p. 306) are as follows:

Period	Fore-Period	Preservative Period	After-Period
1, N in food, grams	17.41	17.43	17.53
2, N in feces, grams	1.44	1.49	1.536
3, N in urine, grams,	14.96	14.92	14.23
4, N in feces and urine (2 + 3)	16.49	16.42	15.84
5, N in feces 2 ÷ 1 percent	8.31	8.6	8.8
6, N in urine 3 ÷ 1 percent	86.0	85.5	81.4
7, N in feces and urine, 4 ÷ 1%	94.5	94.1	90.3
8, Balance 1 - 4 grams	0.964	1.02	1.69
9, Body weights, kilos,	66.14	65.46	65.11

Part II.- Salicylic Acid and Salicylates.

A report of experiments similar to those reported in Part I, in which the effect of salicylic acid and salicylates was sought. The investigation was conducted similarly to that described in Part I. The number of subjects was increased to twelve, and all were under observation at the same time. The preservative was administered in tablets and capsules. The experiment continued for 55 days. Food, feces, and urine were analysed and the nitrogen balance was determined.

Nitrogen Balance

(Average from summary for nine men) Series VI.

	Fore-Period	Preservative-Period	After-Period
In food, grams	15.46	15.37	15.46
In feces, grams	1.29	1.15	1.21
In urine, grams	13.50	13.51	13.56
In feces and urine, grams	14.79	14.66	14.77
In feces, percent	8.33	7.50	7.83
In urine, percent	87.32	87.89	87.75
In feces and urine, percent	95.64	95.39	95.58
Balance, grams	+.67	+.71	+.69
Salicylic acid, grams	0.00	1.02	0.00

Regarding the influence of the preservative upon nitrogen metabolism, the author says: "The administration of salicylic acid increased the katabolic activities of the organ, resulting in an increased excretion of the solid matter in the urine". The data indicate that the preservative tends to increase slightly the digestibilities and absorption of the nitrogen ingested.

In a supplementary experiment, the effect of the preservative on the distribution of the nitrogenous constituents of the urine was studied. Two men were placed upon a salicylic acid diet; two on a salicylate diet. Total nitrogen, the nitrogen present as urea, as uric acid, as xanthin, as kreatinin, and as ammonia were separately determined. The methods employed were:

for urea, Morner-Sjöqoist (68)*and Braumstein.

uric acid, Folin's modification of Hopkin's method, (37).
kreatinin, Folin (35).

xanthin, Kruger-Schmidt.

Nitrogenous Constituents of Urine

Average from Summary of the four Subjects.

Period	Fore-Period	Preservative-Period	After-Period
Total nitrogen ingested, grams	16.72	17.00	17.00
Nitrogen in urine (grams)			
Total	14.12	13.96	13.41
As urea	12.94	12.73	12.31
As uric acid	.17	.15	.17
As xanthin	.04	.04	.01
As kreatinin	.49	.54	.47
As ammonia	.27	.21	.27
Undetermined	.21	.28	.27
Percent of ingested nitrogen in urine	84.4	82.1	78.9
Percent of total nitrogen of urine determined as			
Urea	91.6	91.2	91.8
Uric acid	1.2	1.1	1.3
Xanthin	0.3	0.3	0.1
Kreatinin	3.5	3.9	3.5
Ammonia	1.9	1.5	2.0
Undetermined	1.5	2.0	1.3

*The numbers in brackets refer to the references given in this Bibliography.

Part III.- Sulphurous Acid and Sulphites.

This investigation, to determine the influence of sulphurous acid and sulphites upon digestion and health, was conducted practically the same as that reported in Part II. Twelve men were used as subjects. Six were fed upon a diet containing sodium sulphite (administered in capsules); six upon a diet containing sulphurous acid (in the drinking water). Supplemental experiments to determine the effect of the preservatives upon the distribution of the nitrogenous elements in the urine were made as in Part II and simultaneously with those there reported.

Nitrogen Balance

Average per man per day from summary for first 6 men

Period	Fore-Period	Preservative-Period	After-Period
In food, grams	17.77	17.42	16.71
In feces, grams	1.33	1.49	1.25
In urine, grams	15.12	15.19	14.74
In feces and urine, grams	16.45	16.67	15.99
In feces, percent	7.50	8.54	7.47
In urine, percent	85.10	87.17	88.17
In feces and urine, percent	92.60	95.71	95.64
Balance, grams	1.32	.75	.72
Sodium Sulphite ($S O_2$)	0.00	0.484	0.00
Body weights, kilos	63.71	62.78	62.28

Ditto for second group of six men

In food, grams	17.71	17.46	17.55
In feces, grams	1.42	1.53	1.62
In urine, grams	14.27	13.81	14.24
In feces and urine, grams	15.69	15.35	15.86
In feces, percent	8.04	8.78	9.26
In urine, percent	80.55	79.10	81.13
In feces and urine, percent	88.59	87.88	90.38
Balance, grams	2.02	2.11	1.69
Sulphurous Acid ($S O_2$)	0.00	0.343	0.00
Body weights, kilos	61.87	62.00	62.07

The effect of the preservative upon nitrogen metabolism is not strongly marked. There is an increase in non-metabolized nitrogen during the preservative period.

Distribution of the Nitrogenous Constituents of the Urine

Average from summary for three men

Period	Fore- Period	Preservative- Period	After Period
Total nitrogen ingested, grams	15.69	15.69	15.69
Nitrogen in urine (grams)			
Total	12.58	12.15	12.32
Urea	11.41	10.93	11.30
Uric acid	.18	.17	.17
Xanthin	.04	.03	.02
Kreatinin	.50	.52	.49
Ammonia	.22	.20	.23
Undetermined	.24	.30	.09
Percent of ingested nitrogen in urine	80.18	77.44	78.52
Percent of total nitrogen of urine determined as			
Urea	90.68	89.98	91.76
Uric acid	1.45	1.41	1.40
Xanthin	.29	.24	.14
Kreatinin	3.96	4.27	3.94
Ammonia	1.75	1.64	1.84
Undetermined	1.87	2.45	.73

In the special study, a decrease in the quantity of urea excreted during the preservative period is shown. There is also a decrease in the total nitrogen excreted, a fact which is contrary to the tendency shown by the data in the nitrogen balance table. Weather conditions and the fact that only three men took part in the special study, make the results of the other the more important.

4. Folin, Otto. Approximately complete analyses of thirty "normal urines".

American Journal of Physiology (1905) 13, pp. 52-65.

This article is a record of thirty fairly complete analyses of normal 24-hour quantities of urine, corresponding to a "standard diet". They are presented because in "all the voluminous urine literature there is still no record of the complete analysis of any one concrete sample of a normal 24-hour quantity". The thirty urines were obtained from six different normal persons who were all kept for seven days on one standard uniform diet. The first two 24-hour quantities were discarded and only the last five analysed. The methods employed were for total nitrogen, Kjeldahl (copper sulphate plus potassium sulphate); for urea and kreatinin, Folin's methods (31), (32), and (33); for ammonia, Folin's aereation method (34); for uric acid, Folin and Shaffer's method (37).

Nitrogen — Averages

							Average		
							Final	Max.	Min.
Body weights, kilos	57.4	67.0	70.8	70.9	56.6	57.8	63.4	70.9	56.6
Vol. of urine, cc	1812	1196	1444	1242	1645	1239	1430	1812	1196
Total nitrogen, grams	16.6	14.8	16.4	14.8	15.1	18.2	16.0	18.2	14.8
Nitrogen as (in grams)									
Urea	14.3	12.8	14.1	12.8	13.5	16.2	13.9	12.8	16.2
Ammonia	0.85	0.69	0.74	0.77	0.55	0.60	0.70	0.85	0.55
Kreatinin	0.59	0.54	0.59	0.66	0.50	0.59	0.58	0.66	0.50
Uric acid	0.11	0.08	0.10	0.15	0.15	0.15	0.12	0.15	0.08
Undetermined	0.53	0.72	0.85	0.41	0.41	0.66	0.60	0.85	0.41
Percent of total nitrogen in urine determined as									
Urea	87.5	86.2	86.2	86.7	89.4	89.0	87.5	89.4	86.2
Ammonia	4.1	4.6	4.5	5.0	3.6	3.3	4.3	5.0	3.3
Kreatinin	3.6	3.6	3.5	4.5	3.3	3.2	3.6	4.5	3.2
Uric acid	0.7	0.6	0.6	1.0	1.0	0.8	0.8	1.0	0.6
Undetermined	3.10	5.00	5.30	2.80	2.70	3.70	3.75	5.30	2.70

The diet was a special one, a fluid egg and milk diet, containing approximately 119 grams of protein. The nitrogen determination made at different times varied from 18.80 to 19.05 grams. The diet fulfils tne requirements of the so-called dietary standards. With reference to protein it corresponds almost exactly with the value demanded by Voit for a man weighing 70 kilos.

There is no discussion of the data "for the very reason that they correspond so closely to what we have been accustomed to consider normal". Special points are left for the following paper, "Laws Governing the Chemical Composition of Urine". (5)

5. Folin, Otto.

Laws Governing the Chemical Composition of Urine. American Journal of Physiology, (1905) 13, p. 66.

This article is a study of human urines obtained from diets which are as different from the so-called standard diets as they could be made. The first subject studied was a professional man who was accustomed to a diet low in protein. The maximum and minimum of the analyses of his urine, for a period of 10 days, showed the following:

	Maximum	Minimum
Total nitrogen, grams	8.0	4.8
Nitrogen as urea (p.ct. of total urinary nitrogen)	80.4%	62.0%
Nitrogen as ammonia, do.	11.7%	4.2%
Nitrogen as kreatinin, do.	11.1%	5.5%
Nitrogen as uric acid, do.	2.4%	1.2%
Nitrogen as undetermined nitrogen, do.	14.6%	4.8%

These, compared to the results obtained in the analyses of 30 normal urines (4) showed a remarkable "transposition of the nitrogen compounds", the cause of which was naturally sought in the fact that the protein metabolism had been greatly reduced. "In the metabolism literature is to be found considerable evidence

tending to show that the percentage composition of urine is not the same on a diet containing but little protein as in one rich in that constituent".

For a more detailed study of the laws or conditions governing the formation and elimination of the several more important urinary constituents, four feeding experiments, all practically alike, were conducted. Each experiment was divided into three periods. In the first period (three or four days in length) the standard protein rich diet, described in the previous paper (4) was used. The urine eliminated at the end of this period was exactly like that of the subjects of the previous paper. For the second period (7 to 10 days) a complete change in the character of the diet was made. The new diet contained only about one gram of nitrogen. In the third period (1 or 2 days) the first diet was again used. The low nitrogen diet, "the starch and cream diet", consisted of 400 grams of pure starch and 300 cc cream, containing 15 to 20% fat. "With a reduction of the total nitrogen and total sulphur in the urine, we find a smaller percent represented as urea and as inorganic sulphates and a relative increase in the other representatives of these two elements." The laws governing the composition of urines are deduced. Those relating to the nitrogenous compounds are stated as follows:

Kreatinin.- "The absolute quantity of kreatinin eliminated in the urine on a meat free diet is a constant quantity differing for different individuals but wholly independent of the quantitative changes in the total amount of nitrogen eliminated." This fact makes kreatinin the most reliable index as to the amount of a

certain kind of protein-metabolism occurring daily in any given individual. The amount differs for different individuals. It depends chiefly on body weight. Physical conditions, i.e., the amount of adipose tissue present and muscular work, influence the amount, too.

Uric Acid.-"When the total amount of protein metabolism is greatly reduced, the absolute quantity of uric acid is diminished but not nearly in proportion to the diminution in the total nitrogen, and the percent of uric acid nitrogen in terms of the total nitrogen is therefore much increased." The deduction of Burian and Schur (18) that "the 'endogenous' uric acid is for each individual a constant quantity", is questioned.

Ammonia.- "With pronounced diminution in the protein metabolism (as shown by the total nitrogen in the urine) there is usually, but not always, and therefore not necessarily, a decrease in the absolute quantity of ammonia eliminated. A pronounced reduction of the total nitrogen is, however, always accompanied by a relative increase in the ammonia nitrogen, provided that the food is not such as to yield an alkaline ash." Ammonia is a base. Its formation in the animal organism is probably quantitatively determined by the necessity of forming salts. Since the human organism is capable of converting some of these salts into urea, the character of the acids forming these salts determines the amount of ammonia appearing in the urine. The salts not readily changed thus are those of sulphur and phosphoric acid residues, and of certain organic acids.

Undetermined Nitrogen.- "The absolute quantity of undetermined nitrogen decreases under the influence of the starch and cream diet but in percent of the total nitrogen there is always an increase."

Urea.- "Urea is the only nitrogenous substance which suffers a relative as well as absolute diminution with a diminution in the total protein-metabolism." Urea which has always been considered the chief nitrogenous substance and to represent almost 90% of the total nitrogen in normal human urine and in nearly all pathological urines, has been reduced in ten different cases to about 60%. That earlier investigations have not shown this fact, is probably due to errors in the methods used. A decrease to a greater extent, not yet accomplished, is suggested as a possibility.

6. Folin, Otto.

A Theory of Protein Metabolism.

American Journal of Physiology. (1905) 13, p. 117.

An interpretation of protein metabolism on the basis of observed variations in the percentage composition of urine, based (for the greater part) upon the two papers published previously, (4) and (5).

The two fundamental different theories concerning the nature of protein metabolism, that of Pflüger (1893) and that of Voit (1867) are discussed. Voit's theory is: "The protein of the absorbed food passes through the blood to the different tissues and cells, and is there katabolized under the influence of the living protoplasm, but without first becoming an integral part of the

latter." Voit's fundamental conception seems to be that the living protoplasm is in a state of suspension, the circulating protein is in solution and the chemical decompositions that constitute protein katabolism take place only in solution. The small amount of living protoplasm which dies is at first only dissolved, thereby becoming a part of the circulating protein derived directly from the food.

Pflüger's Theory.- "There is a decided chemical difference between circulating protein and living protoplasm. The former is stable towards oxidizing agents. The latter is very unstable. All protein katabolized is first transformed into bioplasm, becomes an integral part of the living tissue, and only as such undergoes the oxidation that is supposed to constitute the most fundamental chemical decomposition of protein metabolism." It is stated that Pflüger admits the possibility that a certain amount of protein may be katabolized in solution.

The chief evidence against Voit's theory rests upon the experiments of Schöndorff (76) which appears insufficient. The chief evidence against Pflüger is the fact that very large quantities of protein are katabolized in a few hours.

Any theory concerning metabolism must harmonize with the laws governing the chemical composition of urine. The accepted views concerning the composition, that quantitative changes in the total protein metabolism do not affect the percentage composition, agree with either Voit's or Pflüger's theory. The percentage composition changes recently noted, do not agree with either.

The author's theory of protein metabolism is based upon his laws governing the chemical composition of the urine. There are two distinct forms of protein metabolism represented by two different sets of waste products. One tends to be constant and is measured by the kreatinin and neutral sulphur elimination. This is termed endogenous or tissue metabolism. The other varies in amount and is termed exogenous or intermediate metabolism. The chief representative of exogenous metabolism is urea.

There is no reason for assuming that the metabolism of protein is brought about by the same chemical processes by which the carbohydrates and fats are decomposed. Protein metabolism is due chiefly to hydrolysis. The standard diets contain too much nitrogen. The body is able to dispose of this rapidly without allowing it to enter into the protoplasm or cell structure. First, protein is changed in the digestive tract to proteoses, amido acids, ammonia and possibly urea. The hydrolytic decompositions are carried further in the membrane of the intestines and in the liver. Each split is such as to further the formation of urea. The excess of protein is not stored. This explains the tendency to keep nitrogen equilibrium. The non-nitrogenous portion of the proteids is converted into fat and carbohydrates by oxidation. Oxidation, too, is necessary to convert protein sulphur into sulphuric acid.

7. Chittenden, Russel H.:

Physiological Economy in Nutrition.

New York, Frederick A. Stokes Co., (1905).

An experimental study to determine a possible physiological economy in nutrition with special reference to the minimal proteid requirement of the healthy man.

The experiments reported were conducted with three distinct types of men. The first group consisted of five professional men (university professors and instructors) who were accustomed to mental rather than physical work. The second group was composed of thirteen soldiers, volunteers from the Hospital Corps of the U. S. Army, and was representative of moderate workers. The third group consisted of eight university students, thoroughly trained athletes (men doing severe physical work). The experiments were conducted through a longer period of time (6 to 9 months) than previous similar ones had been. The diets were not strictly prescribed. The daily output of urine was collected and analysed with special reference to total nitrogen. The data given includes daily (or average for short periods) body weights, volume of urine, specific gravity, nitrogen, uric acid and P_2O_5. The Kjeldahl method was employed for the determination of nitrogen. For uric acid, Folin's method was used. Constancy in body weight was taken as an indication that nitrogen equilibrium existed. To corroborate, equilibrium experiments, extending over periods of six days, were conducted, during which all food and excreta were analysed. The soldiers and athletes were under constant supervision of the director of the Yale gymnasium, and their physical condition at the beginning and the end of the experiment was noted. Psycological tests

reaction time and steadiness, were made on the soldiers and athletes at the beginning and end of the experiment. The blood was studied.

Conclusions:

1. Body weight, health, strength, mental and physical vigor and endurance can be maintained and improved with at least one-half of the proteid food ordinarily consumed (118 grams, the Voit standard).

2. Most individuals, especially those not leading an active out of door life, need less than half of the amount prescribed by ordinary dietary standards (118 grams).

3. Body equilibrium can be maintained on far less than 3000 calories per day by the brain worker. Even those who perform considerable physical work have no need for 3000 calories.

4. The minimum requirement of proteid food is 0.093 to 0.134 grams of nitrogen daily per kilo body weight.

8. Chittenden, Russel H.:

The Nutrition of Man.

New York, Frederick A. Stokes Co., (1907).

A systematic account of our knowledge regarding some of the more important processes of nutrition, with special reference to the needs of the body for food. The book is divided into eight chapters as follows:

I. Foods and Their Digestion.

II. Absorption, Assimilation and the Processes of Metabolism.

III. The Balance of Nutrition.

IV. Source of the Energy of Muscular Work with some Theories of Proteid Metabolism.

V. Dietary Habits and True Food Requirements.
In this chapter, the author discusses his own experiments with professional men and with athletes as reported in his book "Physiological Economy in Nutrition", (7)

VI. Further experiments and Observations bearing on True Food Requirements.
The chapter includes the writer's experiments on soldiers as reported in (7).

VII. The Effect of Low Proteid Diet on High Proteid Animals.
Experiments with dogs as subjects.

VIII. Practical Applications with some Additional Data.

Conclusions.- The plan of living that is moderate and simple, and modeled along scientific and intelligent lines, promises health, strength, longevity, and increased efficiency.

9. Benedict, Francis Gano:

The Influence of Inanition on Metabolism.

Washington, D. C. Carnegie Institution of Washington(1907)

The purpose of the work reported in this book was to study as completely as possible the metabolism in fasting man. Respiratory exchange and heat production were made the special subjects of study. Experiments during prolonged fasting were made to note the fluctuations in metabolism from day to day. A series of 2-day fasts with a number of subjects was included to eliminate the influence of individuality. The rapidity and amount of gain of nitrogen^ous material following a prolonged fast were studied as a closely related supplementary problem. Food, feces, and urine were analysed. Nitrogen was determined by the Kjeldahl method; creatin and creatinin by Folin's method. The subjects were all

students except one who was accustomed to fasting, having done so previously. All were in good health. The fasting experiments were conducted within the Respiration Calorimeter.

Nitrogen Excretion (grams)

Averages of fourteen experiments

(8 2-day, 2 3-day, 2 4-day, 1 5-day, and 1 7-day fasts)

Days	Total	Per kilo Body Weight
First day	10.03	0.156
Second day	12.76	0.202
Third day	13.08	0.213
Fourth day	11.44	0.192
Fifth day	10.43	0.186
Sixth day	10.74	0.190
Seventh day	10.13	0.181

The maximum excretion occurs on the third day. Although the evidence is insufficient for any definite conclusions, the results would imply that after the first fasting day, the supply of reserve protein has little if any effect upon subsequent excretion of nitrogen.

Creatin and Creatinin.

The amount of total creatinin (creatin plus preformed creatinin) remained singularly constant on all days of the fast. The amount of preformed creatinin decreased, while the amount of creatin increased as the fast progressed. Two explana-

nations for these facts are given: (1) They are due to a decrease in the power of the body to dehydrate the creatin resulting from protein katabolism. (2) The fact that the total creatinin remained constant would indicate that tissue katabolism is supplemented by some other source of creatinin. The increase in creatin suggests increase in body-flesh katabolized. The creatinin is derived from the dehydration of creatin or from katabolism of protein. According to this hypothesis the total protein katabolism in the first few days of fasting involves little muscle protein, but as the fast progresses, muscle protein becomes disintegrated and releases creatin which is excreted unchanged. The total creatinin excretion is not affected by the total nitrogen excretion when creatinin free diets are consumed. The total creatinin elimination varies according to the individual and in general with the body weight. The excretion of creatinin per kilo body weight is not influenced by proportion of body fat and height.

Uric Acid.

The little data collected seem to indicate that remarkable small amounts of uric acid are excreted by fasting man after the first one or two days of fast.

In one 1-day and three 3-day experiments with food, which were conducted in the calorimeter and followed immediately after two of the fasting experiments, the data show a marked decrease in the nitrogen excretion on the second and third days. Since the nitrogen of the food remained constant, this indicates a tendency of the body to adjust itself to the new condition of protein ingestion. In one experiment the body is nearly in nitrogen equi-

librium on but 6.37 grams of nitrogen, even after a prolonged draft upon body protein.

Two metabolism experiments extending over longer periods and conducted outside of the calorimeter, followed the experiments just described. The most striking feature of these is the enormous gain of nitrogen shown during the first and second weeks of the first experiment. There are no definite relationships between gains and losses of nitrogen. The subject of both experiments was the same person.

Nitrogen Balance (Experiments 1 and 2).

Average per day by weeks

	Weeks			
	1	2	3	4 (4 days)
Experiment No. 1				
Nitrogen in food	21.11	21.80	17.38	15.67
Nitrogen in feces	2.35	3.88	2.79	2.54
Nitrogen in urine	10.60	10.56	11.40	11.86
Balance	+8.17	+7.36	+3.19	+1.27
Experiment No. 2				
Nitrogen in food	19.61	19.41		
Nitrogen in feces	2.46	2.36		
Nitrogen in urine	14.13	12.48		
Balance	+3.02	+4.57		

The book contains a comprehensive review of the literature on metabolism during inanition. In connection with nitrogen the data from the most important previous experiments are tabulated and arranged in a way that permits comparison.

10. Atwater, W. O. and Sherman, H. C.:

The Effect of Severe and Prolonged Muscular Work Upon Food Consumption, Digestion and Metabolism.

Bulletin No. 98, Experiment Stations, U. S. Dept. Agriculture.

11. Abderhalden, Emil:

Abbau und Aufbau der Eiweisskörper im thierischen Organismus.
Zeitschr, f. physiol. Chemie. Band 44, p. 27.

12. Albu:

Berliner Klinische Wochenschrift (1904) XLVII, p. 1228.

13. Atwater:

Atwater's Standard Diet.

Bulletin No. 46, U. S. Dept. Agriculture, p. 63.

14. Atwater and Bryant:

Further Dietary Studies of University Boat Crews.

Bulletin No. 75, Ex. Sta. U. S. Dept. Agriculture, (1900).

15. Benedict, F. G., and Myers U. C.:

Creatinin Excretion in Women.

Am. Journal Physiol., Vol. 18, No. 4, (1907) p. 377.

16. Breisacher, L.:

Über die Grösse des Eiweissbedarfs beim Menschen.

Deutsche Med. Wochenshrift, (1891), No. 48.

17. Bunge:

Textbook of Physiological and Pathological Chemistry.
Second English edition, 1902.

18. Burian and Schur:

Archiv. f. d. gesammte Physiologie Band LXXXVII p.239
(1900) Ibid " LXXX p.241
" " XCIV p.273

19. Camerer:

Zeitschr f. Biologie, 1903, XIV, p. 1.

20. Caspari:

Ernährung bei verringter Eiweisszufuhr, Ein Beitrag zur Frage der.
Archiv f. Physiologie. Jahrgang, (1901), p. 327.

21. Chittenden, Russel, H.:

Physiological Economy in Nutrition.

Popular Science Monthly, June, 1903.

22. Classon:

Concerning the excretion of creatin per kilo body weight in normal individuals.
Am. Journal Physiology, (1906) 16, p. 252.

23. Cohnheim:

Zeitsch. f. Physiol. Chemie. (1902) XXXVII, p. 174.

24. Cohnheim, Otto:

Zur Spaltung des Nahrungseiweiss im Darm.

Zeitschr f. physiol. Chemie. 49, p. 64.

25. Coirce, Aran:

British Medical Journal, April 7, 1906, p. 829.

26. Curtis, Edward, M. D.:

Nature and Health.

New York, Henry Holt and Co., 1906, p. 39.

27. Dapper, Max:

Über Fleischmast beim Menschen.

Inaug. Disser. Marburg, 1902.

28. Fenger, Dr. S.:

Beiträge zur Kenntniss des Stoffwechsels im Greisenalter.
Skandinavisches Archiv. f. Physiologie, 1904, 16, p. 222.

29. Fisk, Adolf:

Über die Entstehung der Muskelkraft.

Gesammelte Schriften Band 2, p. 85. Wurzbürg, 1903.

30. Fletcher, Horace:

The A-B-Z of our own Nutrition.

New York, 1903, p. 48.

31. Folin, Otto, Zeitschr f. physiol. Chem. 22.

32. " " " " " " 32, 1901.

33. " " " " " " 36, 1902.

34. " " " " " " 37, 1903.

35. " " " " " " 41, 1904, p.223.

36. " " Festschrift für Olof Hammersten, Upsala, 1906.

37. Folin and Shaffer:

Zeitschr f. physiologische Chem. 1901, XXXII.

38. Foster, Sir Michael:

Lectures on the History of Physiology during the 16th, 17th, and 18th centuries.
Cambridge, 1901.

39. Gautier, Armand:

L' Alimentation et les Regimés chez l' Homme Sain et chez les Malades
Paris, 1904.

40. Gottlieb, R. and Stangassinger, R.:

Behavior of Creatin in Autolysis, etc.

Zeitschr physiol. Chem. Vol. 52, (1907), p. 1.
Vol. 55, (1908), p. 324.

41. Gregor:

Zeitshr f. physiologische Chem. (1900) XXXI, p. 98.

42. Gumlich:

Zeitshr f. physiologische Chem. (1892) XVII, p. 19.

43. Hirschfeld:

Untersuchungen über den Eiweissbedarf des Menschen.

Pflügers Archiv. f. die gesammte Physiologie 41, 1887, p. 533.

44. Hirschfeld:

Beiträge zur Ernährungslehre des Menschen.

Virchow's Archif. f. exper. Pathol in Pharm. Band 114, p. 311, 1888.

45. Hirschfeld:

Ernährwng der Soldaten vom physiologischen und volkwirthshaftlichen Standpunkt.
Archiv. f. Physiologie, 1903, p. 380.

46. Hultgren and Landergren:

Untersuchungen u. d. Ernährung schwedischer Arbeiter

Stockholm, 1891

47. Jaksch:

Zeitshr f. klinische Medizin, 1903, 50.

48. Hultgren and Landergren:

Jahresbericht für Thierchemie, 1891, p. 369.

49. Jaksch:

Zeitschr f. physiol. Chem., 1903, 40.

50. Joslin:

Journal of Medical Research, 1904, XII, p. 442.

51. Kaufman:

Zeitshr f. diatetische u. physikalische Therapie, 1903–4, VII, p. 355.

52. Kellner and Mori:

Untersuchungen ü. die Ernährung der Japaner.

53. Kintaro, Oshima:

A Digest of Japanese Investigations on the Nutrition of Man.
Bulletin No. 159, Ex. Sta. U. S. Dept. Agriculture, 1905.

54. Klemperer:

Untersuchungen über Stoffwechsel u. Ernährung in Krankheiten.
Zeitschr f. klin Medizin Band 16, p. 550.

55. Von Klercker:

Beiträge zur Physiol. und Path., (1906) 8, p. 59.

56. Kumagawa:

Untersuchungen ü. d. Ernährung mit gemischter und rein vegetablischer Kost mit Berücksichtigung des Eiweissbedarfes.
Virchows's Archiv. f. Exper. Path. n. Pharm. 116, p. 370, (1889)

57. Kutscher and Seemann:

Centralblatt f. Physiologie, XVII, p. 715, 1904.

58. Landergren:

Untersuchungen ü. d. Eiweissumsetzung des Menschen.

Skandinavisches Archiv. f. Physiol 14, p. 121, (1903)

59. Langstein, Leo:

Die Kohlehydratbildung aus Eiweiss.

Ergebnisse der Physiologie, 3, pt. I, p. 456.

60. Langworthy and Milner:

Investigations on the Nutrition of Man in the United States.
U. S. Dept. of Agriculture, Office of Experiment Station, Washington, 1904.

61. Leathes, J. B.:

Problems in Animal Metabolism.

Blakiston's Son & Co., 1906.

62. Lichtenfelt:

Über die Ernährung der Italiener.

Pflüger's Archiv f. d. gesammte Physiologie 99, p.1,1903.

63. Lüthje.

Zeitshr f. klinische Medizin, 44, p. 22.

64. Lüthje:

Zur Frage der Zuckerbildung aus Eiweiss.

Archiv. f. d. gesammte Physiologie, 106, p. 160.

65. Luthje and Berger:

Deutsches Archiv f. klin Medicin (1904) 81.

66. Macleod, J. J. R.,

Journal of Physiol. Proceedings of the Physiological Society, XXVI, P. VII, 1900.

67. Mellanby:

On Creatin and Creatinin

Journal of Physiol. (Lond.), Vol. 36, (1908), 447–487.

68. Mörner, K. A. K.:

Skandinavisches Archiv. f. Physiol., 1903, XIV, p.297.

69. Nakahama:

Über den Eiweissbedarf des Erwachsenen mit Berücksichtigung der Beköstigung in Japan.

Archiv. f. Hygiene, Band 8, p. 78.

70. Nencki and Zaleski:

Zeitshr f. Physiol. Chem. 1901, XXXIII, p. 206

71. Peschel:

Untersuchungen ü. den Eiweissbedarf des gesunden Menschen.
Dissertation, Berlin, 1891.

72. Pettenkofer and Voit:

Zeitshr f. Biol. (1866), 2, p. 478.

73. Pflüger, Edward:

Über enige Gesetze des Eiweissstoffwechsels, (Mit besonderer Berücksichtigung der Lehre vom sogenannten "circulirenden Eiweiss").
Archiv, f. d. gesammte Physiol. 54, p. 333.

74. Ranke:

Die Ernährung des Menschen.

Munich, 1876.

75. Schmidt:

D. Militärärzl Zeitshr, 1901, p. 622
(Quoted by Hirschfeld, (45))

76. Schöndorff:

Archiv. f. d. gesammte Physiologie, 1893, LIV, p. 420

77. Seeman, J.:

In Regard to Creatinin Formation,

Zeitschr f. Biol., Vol. 49 (new series 31), 1907, p.333.

78. Shaffer:

Am. Journal Physiol., 1903, VIII, p. 331.

79. Shaffer, Philip:

Excretion of Creatinin and Creatin.

Am. Journal Physiol., 23, 1908, p. 1.

80. Siven:

Stickstoffgleichgewicht beim Erwachsenen Menschen

Skandinavisches Archiv. f. Physiol. Band, 10, p. 91.

81. Siven:

Zur Kenntnis des Stoffwechsels beim erwachsenen Menschen.
Skandinavisches Archiv. f. Physiol. 11, p. 308, (1901).

82. Studemund:

Ein Beitrag zur Lehre vom Eiweissbedarf des gesunden Menschen.
Pflüger's Archiv. f. d. gesammte Physiol. 48, p. 578.

83. Van Hoogenhuyze and Verploegh:

Beobachtungen ü. d. Kreatininausscheidung beim Menschen.
Zeitschr f. physiol. Chemie., (1905) 46, p. 415.

84. Voit, C.:

Hermann's Handbuch der Physiologie des Gesammt-Stoffwechsels. Band 6, Theil 1, (1881).

85. Woods and Mansfield:

Studies of the Food of Maine Lumbermen.

Bulletin 149, U. S. Dept. Agriculture, 1904.

86. Shaffer, Phillip A.;
Muscular Activity and Protein Metabolism
Am. Jour. of Physiol., XXII, No. 4, 1908, p. 454.

SUMMARY.

The Function of Nitrogen in Food.

Plants produce organic matter from inorganic substances. Animals cannot do this. They can form organic matter only from other organic substances taken directly from plants or indirectly as animal food. Foods serve two purposes; they supply the heat and energy for muscular work and also the material for the body tissue. Since animal tissue is nitrogenous, nitrogenous food is necessary for its synthesis. "Of the two kinds of nitrogenous food, proteids and albuminoids, proteids only are of avail." (26) Nitrogen metabolism, then, is identical with protein metabolism.

Earlier investigators asserted that protein supplied not only the material for tissue structure, but that it was also the chief source of muscular energy. Fick (29) proved that the oxidation of proteid was not the sole source of muscular energy. Bunge (17) declared that muscular work is maintained chiefly from the supply of non-nitrogenous food and that not until this is unavailable, are the proteids attacked. Langstein (59) and Luthje (64) stated that in the ordinary katabolic processes there is a tendency for the nitrogen of the proteid molecule to split off, leaving a carbonaceous residue which is oxidized more slowly than the nitrogenous portion and may be temporarily stored in the body as fat or carbohydrate. According to Leathes (61) protein metabolism as far as it is concerned with the production of energy may be almost non-nitrogenous metabolism. Nitrogen in metabolism, then, is concerned chiefly with the tissue building and disintegration.

Theories of Proteid Metabolism.

Folin (6) has discussed at length the two important theories of protein metabolism, that of Voit and that of Pflüger. Both are based upon the assumption that the chemical composition of urine, or the percentage composition, does not vary with the total nitrogen metabolized. Folin (5) and others; (Siven (81), Gumlich (42), Burian and Schur (18), and Camerer (19)) have demonstrated that the percentage composition of urine does vary with the total nitrogen metabolized. Basing his conclusions upon the study of the variation, Folin has formulated his laws governing the chemical composition of urine (5) and his Theory of Protein Metabolism (6). He has distinguished two kinds of metabolism, endogenous or tissue and exogenous or intermediate. According to his theory, the amount of nitrogen that should be metabolized is a quantity sufficient for endogenous metabolism plus enough to maintain a sufficient supply of reserve protein. This leads to the question of minimal protein requirement and actual protein metabolism.

Standard Diets. Minimal Proteid Requirement. Quantities of Nitrogen Metabolized.

Voit's standard diet for a man weighing 70 kilos and performing a moderate amount of muscular work was 118 grams protein, 500 grams carbohydrates and 56 grams of fat, a diet with a fuel value equal to 3055 calories. Ranke (74) stated that the daily diet consists of 100 grams of proteid, 240 grams carbohydrates and 100 grams of fat, fuel value 2324 calories. Atwater, from a large

number of experiments conducted in this country, concluded that for a man doing severe muscular work a more liberal allowance of protein was desirable, 125 grams, the diet possessing a total fuel value of 3500 calories. In these experiments only the composition of food digested was determined.. The results therefore show only approximately the actual quantities of nitrogen metabolized under the conditions. Atwater and Bryant (14) found that university athletes consumed 171 grams of proteid in one case, 160 grams in another, and as much as 270 grams in a third. These results can, however, hardly be considered normal. Lichtenfelt (62) states that an Italiam laborer doing a moderate amount of work requires 110.5 grams of proteid, while at hard labor he needs 146 grams of proteid daily. Gantier (39) says that the French people require ordinarily 110 grams albuminous food, 68 grams fat, and about 423 grams of carbohydrates. If no work is done, the albuminous food can be reduced to 78 grams providing 50 grams of fat and 485 grams of carbohydrates are added to the diet. When eight to ten hours work is done the albuminous food must be increased to 135 grams, the fat to 85 to 100 grams, and carbohydrates to 500 to 900 grams. Woods and Mansfield (85) found that the average daily amount of protein ingested in the case of fifty Maine lumbermen was 185 grams. Hultgren and Landergren (48) state that the daily diet of Swedish laborers doing hard work is 189 grams of proteid, 110 grams fat, 714 grams carbohydrates, with a fuel value of 4726 calories.

On the other hand, nitrogen equilibrium has been maintained on much smaller quantities of proteid food. Klemperer (54) in an experiment on two young men (weighing 64 and 65.5 kilos)

found that nitrogen equilibrium was established on 4.38 and 3.58 grams of nitrogen for eight days. The diet, however, contained sufficient fat, carbohydrates and alcohol to give it a fuel value of 5020 calories. Hirschfeld (43) kept himself (73 kilos) in nitrogen equilibrium on a diet containing only 5 to 7.5 grams of nitrogen, and having a fuel value of 3750 to 3916 calories. Breisacher (16) experimenting upon himself (57 kilos) observed a daily excretion of nitrogen during 30 days of 8.23 grams, on a diet containing 67.8 grams proteid and having a total fuel value of 2866 calories. Siven (80) maintained nitrogen equilibrium for 32 days on 6.26 grams of nitrogen. In another experiment, nitrogen equilibrium was established on 4.5 grams for a day or two at least. Kumagawa (56) on a purely vegetable diet containing 54.7 grams proteid secured a storage of 4 grams proteid per day for nine days. The nitrogen in the urine was 6.09 grams. His body weight was 48 kilos. Caspari (20), weighing 66.2 kilos, maintained nitrogen equilibrium on 13.26 grams of nitrogen per day but could not do so on 10.1 grams.

In reviewing 307 experiments, Neuman (2) found that, when the data was calculated uniformly to correspond to a body weight of 70 kilos, in 181 cases the Voit standard of 118 grams of protein was not reached; in 126 cases, the Voit standard was exceeded. He, himself, maintained nitrogen equilibrium for some time on 76.5 grams protein.

Chittenden (7) determined the minimal protein requirement of healthy man to be .093 to .134 grams of nitrogen per day per kilo body weight and demonstrated in several experiments

that that quantity was sufficient to maintain equilibrium and was most efficient in general. The same investigator (21) in an earlier experiment found that body weight (75 kilos) remained constant when the amount of protein metabolized daily was 41.25 grams. A six day balance period showed the following results.

Nitrogen (grams)

Ingested	Excreted			Balance
	In urine	In feces	Total	
7.19	6.30	0.6	6.90	+0.29

The total fuel value was 1606 large calories. In this experiment thorough insalivation was practiced.

Benedict (9) in experiments without food, reports a nitrogen excretion per kilo body weight varying from 0.202 grams on second day of the fast to 0.181 grams on the seventh day. These quantities are considerably larger than those given by Chittenden as the minimal requirement, yet they represent the amounts metabolized by subjects at rest while receiving no new supply. The subject who underwent the seven day fast very nearly maintained equilibrium on 6.37 grams of protein in a 3-day food experiment following the fast. In the 5-week, metabolism experiment with food (metabolism experiment No. 1) the body took on large amounts of nitrogen, while the amounts katabolized were less in this case than in the starvation experiments. Evidently then the quantities of protein katabolized during fasting do not measure the mininal requirements.

In Wiley's work upon the influence of preservative and artificial colors on digestion and health (3), the quantities of nitrogen metabolized vary in the different cases. In Part I the average amount ingested in 17.46 grams, and the balance is 1.22 grams for an average body weight of 65.64 kilos. In Part II, the average amount ingested is 15.43 grams and the balance is 0.69 grams for an average body weight of 65.57 kilos. In Part III the average quantity ingested is 17.30 grams for the first group of six men; the balance is +0.93 grams and the average body weight is 62.92 kilos. For the second group of six men, the total nitrogen ingested is 17.57 grams; the balance is +1.94 grams and the body weight 61.96 kilos. These results agree closely with the standards of Voit and Atwater.

A general review of the literature concerning the metabolism of nitrogen, then, shows that the quantities of nitrogen actually metabolized vary greatly. As a normal maximum quantity, the amount called for by the Voit and Atwater standards may be taken. Chittenden's standard may be considered the normal minimum quantities. Calculated for a body weight of 70 kilos, these are:

		Total per day Nitrogen–grams.	Per kilo body weight per day Nitrogen – grams.
Maximum	Voit,	18.89	0.290
	Atwater,	20.0	0.286
Minimum	Chittenden,	5.82 to 8.38	0.093 to 0.134

The great variations indicated are due to many factors, chief of which are:

1. Body weight.- In general, the nitrogen metabolism is proportional to the body weight for each individual.

2. Custom.- A plentiful supply of proteid foods and the ability to purchase these lead to their extensive use. Where such foods are not available, a diet low in nitrogenous material suffices, (Coirce, (25)).

3. Muscular Work.- Muscular work increases the amount of tissue disintegrated and in this way increases the nitrogen katabolism. The cutaneous excretion of nitrogenous material is a factor to be considered in metabolism experiments and this, in part at least, is dependent upon the muscular work.

4. Digestibility.- The amount of food that is actually metabolized depends upon its character. Hirschfeld (45) states that not more than 75% of ingested proteid can be digested and absorbed in the case of many vegetables. This is a point to be considered, too, in studying the nutritive value of a given diet. Thorough mastication and insalivation, as pointed out by Fletcher (30) aid digestion and hence influence the actual amount of protein metabolized.

Urinary Nitrogen Expressed as Percent.

It is interesting to note the percentage of the total ingested nitrogen that appears in the urine. The quantity appearing in the urine depends upon the digestibility of the food and upon the condition of the body as regards the necessity or desire to store nitrogenous material for reserve. In normal

conditions, where nitrogen equilibrium is maintained, the amount appearing in the urine will very nearly be the quantity actually metabolized. Some of the results noted in the literature studied are as follows:

	Percent of Total Nitrogen appearing in Urine.	
Wiley (3), Part I,	84.2%	Average for entire experiment.
Wiley (3), Part II,	87.65	Average for entire experiment.
Wiley (3), Part III,	86.81	Average for first group of 6 men.
Wiley (3), Part III,	88.95	Average for 2d group of 6 men.
Folin (4),	86.8	Average of 30 normal urines.
Folin (4),	89.4	Maximum of 30 normal urines.
Folin (4),	86.3	Minimum of 30 normal urines.
Benedict (9),	50.2	First week following a 7-day fast
	75.7	Fourth week following 7-day fast.

In this last experiment, the body had lost its supply of reserve protein during the seven day fast and was evidently recuperating. During the first week, it took on daily an average of 38.7% of the nitrogen ingested.

Nitrogenous Constituents of the Urine.

The importance of determining the nitrogenous constituents of the urine has been pointed out by Folin (5) and the significance of the various constituents has been demonstrated there. In his article on the Analysis of Thirty Normal Urines (4), the same investigator has given the composition of thirty normal urines obtained from subjects consuming a normal diet practically agreeing

with Voit's standard. No comment regarding the results was thought necessary "for the very reason that they correspond so closely to what we have been accustomed to consider normal". The average composition of normal urine as regards nitrogen, then, may be considered as follows: (Body weight, 70 kilos.)

	Grams per Day	Percent of Total Nitrogen
Total nitrogen,	17.7	
Urea, nitrogen,	15.4	87.0
Ammonia, nitrogen,	0.77	4.35
Kreatin, nitrogen,	0.65	3.67
Uric acid, nitrogen,	0.13	0.73
Undetermined, nitrogen,	0.66	3.72

Regarding the method and the value of determining the above constituents, Folin says – that compared to the older methods it is much more satisfactory. The older methods were based on the use of phosphotungstic acid as a precipitant. This was supposed to precipitate quantitatively all the nitrogenous products except urea and traces of monamido acids which were determined in the filtrate. A series of additions and subtractions gave the diamido acids (so-called). Other investigators (Mörner (68) and Jaksch (49)) have found this method unsatisfactory in quantitative urine analysis. The newer method, on the other hand, gives a clearer knowledge of the character of the metabolic processes that take place.

Urea.- Urea has always been regarded as constituting almost 90% of the total nitrogen of the urine, in normal cases. Exceptions have been noted, as the ones reported by Folin. It is a measure of the exogenous metabolism and is directly proportional to the total nitrogen eliminated and, hence, in normal cases, to the total nitrogen ingested.

Ammonia.- In normal urines, ammonia constitutes about 4.35% of the total nitrogen. Its formation in the body depends upon the character of the diet. As pointed out by Folin (5) the body has the power to convert certain ammonium salts of organic acids to urea. Joslin (50) states that an excessive consumption of fat leads to an enormous increase in the ammonia eliminated. The quantity in the urine is not proportional to the total nitrogen but a decrease in the total nitrogen metabolized generally results in a decrease in the quantity of ammonia.

Creatinin.- Creatinin is a measure of the tissue or endogenous katabolism. The amount excreted per 24 hours by a man weighing 70 kilos is, according to Folin, 0.65 grams. Benedict (9) found that in fasting men, the excretion appeared to be constant on all days of the fast but secured results higher than that of Folin: viz., for a body weight of 55.4 kilos, 0.977 grams (minimum); 77.8 kilos, 2.029 grams (maximum). The amount excreted appears to be dependent upon body weight, muscular work, adipose tissue, and quantity of meat contained in diet. On a meat free diet, it is a constant quantity for each individual.

Uric Acid.- About 0.73% of the total urinary nitrogen is present as uric acid, or, expressed in weight, it is equal to 0.13 grams per day. According to Folin (5) the absolute quantity diminishes with the total nitrogen but not nearly in proportion to it. Shaffer (86) however, has found that it was not higher with 11 grams total nitrogen than it was with 4 grams total nitrogen (with a non-purin diet). His results corroborate the conclusions of Burian and Schur (18) that "the 'endogenous' uric acid is for each individual a constant quantity".

Undetermined Nitrogen.- The nitrogen termed undetermined nitrogen includes purin basis, amino acids, and many bodies not yet identified. In normal urines, 3.72% of the total nitrogen is present in these forms. Expressed in grams, the quantity is 0.66 grams.

Part Two.

A study of the nitrogen data obtained in an extended metabolism experiment with twenty-four men.

For a further consideration of the metabolism of nitrogen in man under normal conditions, a collection of data is included here, obtained in a metabolism experiment extending from January 4, 1908 to July 29, 1908, a total of 208 days.

The subjects were twenty-four young men, university students, all in good health. Their mode of life was that of the average university student, a moderately active one both mentally and physically. During the time of the actual experiment and for some weeks previous to its beginning they lived in two adjacent

houses, under sanitary, healthful and pleasant conditions. The diet was a normal one, consisting of vetables, cereals, fruits, meat, coffee, cocoa, etc. Each subject was allowed to choose the quantity desired previous to the experiment in order to determine the amounts of foodstuffs that he was accustomed to ingest. After the quantities had been determined, they were carefully measured in order to secure the daily ingestions of a uniform amount of each element. This was done as far as practicable but no one was forced to eat more at any time than he desired. All food served was weighed or measured, and all not eaten likewise accounted for. All foods were carefully sampled each day and composited and analysed every four days. The urine was collected in daily portions, and also composited and analysed every four days. The feces were collected daily and composited and analysed every eight days. Total nitrogen and moisture were determined in the composite samples of foods and feces. Total nitrogen and nitrogen present as urea, ammonia, creatinin and uric acid were determined in the urine and undetermined nitrogen was gotten by difference. The methods employed were: for total nitrogen, Kjeldahl-Sherman; for urea, Folin and Benedict; for creatinin, Folin's colorimetric; for ammonia, Folin's aereation; for uric acid, Folin-Shaffer.

The data included in this thesis were obtained from the original data for four and eight day periods by averaging them for sixteen day periods. The numbers given under the heading "Period No." refer to the four day periods. This is true for all data relating to nitrogen and its forms. In Table 1, are given the body weights for the twenty-four subjects. The average weight

of each man for the entire experiment (208 days), and the maximum and minimum weights during this time are given, together with the averages for the entire experiment, of the four groups of six men each into which the entire squad was divided, and the average for the 208 days of the entire twenty-four men. These body weights were calculated from figures for eight day periods.

The squad was divided into four groups (a, b, c, d,) of six men each. The average quantities of ingested nitrogen, total urinary nitrogen, and various nitrogenous constituents of the urine for twenty-four hours; the percentage of ingested nitrogen excreted in the urine and the percentage of the total urinary nitrogen present in the various forms determined are found in Tables 2 to 14 for the four groups and for the entire squad . By combining these data for groups in this way, the personal factors of the individuals are to a great extent eliminated and a more abstract and general consideration is possible. The average for the entire squad allows, of course, the most general conclusions. The remaining tables present the data for the individual subjects. In Tables 15 to 18 are found the quantities of ingested nitrogen for twenty-four hours; in Tables 19 to 26, the total urinary nitrogen for 24 hours and the percentage of ingested nitrogen excreted in the urine; in Tables 27 to 34, urea nitrogen for twenty-four hours and percentages of total urinary nitrogen present as urea; in Tables 35 to 42, similar data for ammonia nitrogen; in Tables 43 to 50, for creatinin nitrogen; in Tables 51 to 58, for uric acid nitrogen; in Tables 59 to 66, for undetermined nitrogen.

The experiment is divided into three sub-periods: the first extending from January 4 to March 23; the second from March 24 to June 27; and the third from June 28 to July 29. These sub-periods correspond to the seasons of the year; winter, spring, and summer. Averages for the sub-periods are given in all cases. Averages for the entire experiment are presented in all cases too, and the quantities per kilo body weight have been calculated.

In the review of nitrogen metabolism presented in Part One of this paper, some decided variations and different conclusions were found. No doubt these differences are due to the different conditions under which the experiments were conducted. Personality, length of experiment, kind of diet, accuracy and thoroughness of methods and analyses are factors that influence the results and the character and quantity of metabolism. In the experiment here reported, the errors due to these sources are to a great extent eliminated. The fact that twenty-four subjects were used does away with the personality factor. The experiment lasted 208 days and extended through winter, spring, and a portion of the summer, a sufficient length of time to give accurate and true results. The influence of seasons and weather, too, can be noted. The diet was a perfectly normal one. All foods and all excreta were carefully measured and analysed.

Body Weights and Nitrogen Equilibrium.

Table 1 shows that during the entire experiment the variation in the body weights were slight. It is also true that during the 208 days every subject either practically maintained nitrogen equilibrium or put on nitrogen.

Ingested Nitrogen.

The quantity of ingested nitrogen for twenty-four hours, as determined from the averages for the 208 days, varies from 10.52 grams (Subject 23, Table 17) to 15.78 grams (Subject 4, Table 16). Per kilo body weight, the amount ingested for twenty-four hours varies from 0.177 grams (Subject 6, Table 16) to 0.231 grams (Subject 24, Table 18). The figures for the groups (Table 2) show a much smaller difference. Here the minimum quantity is 13.04 grams and the maximum 13.70 grams. Per kilo body weight the variation is from 0.195 grams to 0.210 grams. The average for the entire experiment for the twenty-four men is 13.37 grams per twenty-four hours, or, calculated per kilo body weight the quantity is 0.202 grams per twenty-four hours. This quantity is considerably less than that called for by the Voit standard (0.270 grams per kilo body weight for 24 hours), and is more than the standard set by Chittenden (0.093 to 0.134 grams per kilo body weight per 24 hours). In fact, it is exactly the mean of Voit's standard and the maximum of Chittenden's two values.

In general, there is a tendency for the quantities ingested to decrease as the experiment progresses, but this decrease is not very marked. A comparison of the figures for the four groups shows a slight decrease in the cases of groups a, b, and c, and a slight increase in the case of group d. The averages for the four groups show that the quantity ingested during the winter months (first sub-period)(13.40 grams) is practically identical with the quantity ingested during the spring months (second sub-period)(13.43 grams). During the third sub-period the quantity decreased slightly, being 13.09 grams.

Total Urinary Nitrogen.

The total quantity of nitrogen appearing in the urine per 24 hours, average for 208 days, varies from 8.39 grams (Subject 14, Table 21) to 12.55 grams (Subject 4, Table 21). Per kilo body weight, the average for 24 hours for the whole experiment varies from 0.135 grams (Subject 7, Table 21) to 0.191 grams (Subject 24, Table 25). As in the case of the ingested nitrogen, the differences in the amounts excreted, when averaged for the groups, are much less. The minimum quantity is 10.44 grams, (Group a), the maximum is 11.14 grams (Group d). Per kilo body weight, the minimum quantity is 0.157 grams (Group a) and the maximum 0.171 grams (Group d). The average for 24 men for 208 days is 10.80 grams, or calculated per kilo body weight is 0.162 grams.

The general tendency is for the quantities to decrease as the experiment continues through the warmer months, as in the case of ingested nitrogen. The grand average for the first 80 days is 10.92 grams. During the second sub-period it is practically the same, 10.95 grams. During the last 32 days, it decreases to 10.80 grams. The influence of the seasons is seen more clearly from the results in Table 4, "Percentage of Ingested Nitrogen Excreted in the Urine". The grand average for the first sub-period is 81.54%; for the second, 81.21%; and for the third 78.40%, a noticeable decrease in each case. During the warmer months a considerable quantity of nitrogen is excreted in the perspiration. It has been found that during work the nitrogen of organic matter excreted through the skin may amount to 0.22 grams per hour.*

*Journal of Biol. Chem., 1906, 1, p. 263.

Benedict (9) in two inanition experiments conducted within the calorimeter, found an average cutaneous excretion of nitrogen amounting to 0.029 grams per day.

The ratio of total urinary nitrogen to ingested nitrogen ranges from 75.31% (Subject 7, Table 22) to 84.98%, (Subject 20, Table 26). The grand average for the entire experiment is 80.91%. This is a somewhat smaller proportion than has been found by other recent investigators. In Wiley's experiments the percentage varied from 84.2% to 88.95%. The analyses of 30 normal urines by Folin showed a variation of 86.3% to 89.4%, the average being 86.8%.

Urea Nitrogen.

The average quantity of urea nitrogen excreted per 24 hours is 9.02 grams (grand average for 24 men, 208 days). Per kilo body weight this becomes 0.136 grams. According to Folin, normal urines contain 15.4 grams per day (calculated for body weight of 70 kilos) or 0.220 grams per kilo body weight.

The minimum quantity (average for 208 days) is found in the case of Subject 14 (Table 29), 6.95 grams; the maximum in the case of Subject 4, (Table 29), 10.40 grams. Per kilo body weight the variation is 0.109 grams (Subject 7, Table 29) to 0.165 grams (Subject 24, Table 33). The differences in the group average are less. The average for Group a is 8.55 grams; or 0.128 grams per kilo body weight. The average for Group d is 9.39 grams, or 0.144 grams per kilo body weight.

Urea is a measure of the exogenous metabolism and as such should be proportional to the total urinary nitrogen. The percent of total urinary nitrogen present as urea, however, decreases decidedly as the experiment progresses. Table 6 shows that the decrease is general and is found in the case of each group. In the average for the entire squad, the percent of total nitrogen present as urea changes from 84.49% for the first sub-period to 83.56% in the second sub-period, and to 81.66% in the third sub-period. Here again, in a very clear manner, is apparent the influence of seasons, an influence acting not only upon the total nitrogen metabolism, but upon its form as well. As has been pointed out, the cutaneous excretion of nitrogen is a factor of some importance. Moreover, the nitrogen of perspiration is present chiefly as urea. No doubt, then, the decrease in the ratio of urea nitrogen to total urinary nitrogen during the warmer months is due to the fact that a considerable portion of the urea is excreted in the perspiration and is not accounted for.

The percentages of urinary nitrogen present as urea, vary from 80.85% (Subject 16, Table 28) to 87.55% (Subject 9, Table 28). The average for the 24 men is 83.63%. Urea nitrogen has always been considered to constitute about 90% of the total nitrogen of the urine. In the experiments of Wiley, the percent was about 90. In the analyses of 30 normal urines, Folin found it to be 87%.

Ammonia Nitrogen.

The minimum and maximum quantities of ammonia nitrogen excreted per 24 hours (averages for entire experiment) are 0.339 grams, (Subject 5, Table 41), and 0.629 grams (Subject 4, Table 37). The average for all 24 men is 0.449 grams. Per kilo body weight the minimum and maximum quantities are 0.0048 grams (Subject 2, Table 39), and 0.0082 grams (Subject 3, Table 37). The average for the entire squad is 0.0068 grams. This is considerable more than found by Wiley in his short experiments and much less than the amount determined by Folin in his analyses of normal urines. The latter amounted to 0.011 grams per kilo body weight.

There is very little regularity shown in the quantities excreted, and in the proportions that these bear to the total urinary nitrogen. The ratio of ammonia nitrogen to total urinary nitrogen varies from 3.20% (Subject 5, Table 42) to 5.33% (Subject 16, Table 36). The average for the 24 men is 4.20%. This is very near the ratio found by Folin for normal urines, 4.35%. It is, on the other hand, much greater than that determined by Wiley, who found it to be about 1.8%.

Creatinin Nitrogen.

The excretion of creatinin and its physiological significance are questions which are receiving a great deal of attention at the present time. According to Folin's theory, it is a measure of the tissue metabolism and is a constant quantity for each individual on a meat free diet. The diets in the experiments under discussion contained meat in all cases. There is,

however, a certain degree of constancy in the quantities for the first two sub-periods in practically all cases. During the last sub-period the quantities have increased considerably except in the cases of Subjects 14 (Table 45), and 21 (Table 47). The excretions of Subject 11 (Table 49) are fairly constant throughout. In this fact is seen the effect of season again. During the last sub-period more opportunities for muscular activity was offered. Muscular work increases the endogenous metabolism and hence the creatinin elimination.

A point of interest in this connection is the relation of the quantities per kilo body weight excreted by the individual subjects. The minimum is that of Subject 10 (Table 49), 0.0088 grams; the maximum that of Subject 5 (Table 49), 0.0115 grams. The difference between the two is not very great. The group averages (Table 9) show a remarkable small variation. The average for group a is 0.0102 grams per kilo body weight. For the other three groups, the quantities are equal, 0.0105 grams. The average for the twenty-four men is 0.0104 grams.

The minimum amount per 24 hours is found in the case of Subject 14 (Table 45), 0.610 grams; the maximum in the case of Subject 2 (Table 47), 0.838 grams. The average for the twenty-four men is 0.690 grams. In percent of total urinary nitrogen the minimum is 5.58% (Subject 24, Table 50), and the maximum, 8.07% (Subject 7, Table 46). The average for the twenty-four men is 6.49%. Folin gives as the normal creatinin excretion 0.0093 grams per kilo body weight, a quantity very close to that found in this experiment. Calculated as percent of total urinary nitrogen,

Folin's ratio, 3.67%, is much smaller than the one given here. Benedict in his inanition experiments found a higher daily excretion of creatinin, the quantities ranging from 0.176 to 0.264 grams per kilo body weight. This fact tends to support the view that the source of creatinin is tissue katabolism. Wiley, in his supplementary experiments, finds the daily output of creatinin to be 0.50 grams, 3.6% to 4% of the total urinary nitrogen.

Uric Acid Nitrogen.

The quantities of uric acid nitrogen for 24 hours (averages for 208 days) vary from 0.136 grams (Subject 14, Table 53) to 0.230 grams (Subject 20, Table 57). The average for the 24 men for the entire experiment is 0.191 grams. Per kilo body weight the variation is very small indeed. The minimum is 0.0023 grams (Subject 10, Table 57), and the maximum is 0.0037 grams (Subject 20, Table 57). The average for the entire squad is 0.0028 grams per kilo body weight. The ratio of uric acid nitrogen to total urinary nitrogen ranges from 1.51% (Subject 5, Table 58), to 2.15% (Subject 15, Table 56). The average for the twenty-four men is 1.73%. These figures are higher than those determined by Folin for normal urines. He states that the normal excretion of uric acid nitrogen is 0.0019 grams per kilo body weight and that it represents only 0.73% of the total urinary nitrogen. Wiley found the uric acid nitrogen to constitute 1.1% to 1.45% of the total urinary nitrogen.

There is no regular increase or decrease in the quantities eliminated as the experiment progresses. In fact, in all cases there is a noticeable constancy in the daily elimination. This is apparent in the group averages (Table 11). In the grand average for the whole squad the excretion during the first sub-period is 0.191 grams, during the second sub-period 0.184 grams, and during the last sub-period 0.183 grams. The excretion of uric acid nitrogen appears to be a constant quantity.

Moreover, it is directly proportional to the total urinary nitrogen. That the ratio of uric acid nitrogen to total urinary nitrogen is fairly constant is shown by Table 12. According to Folin, the absolute quantity diminishes with the total nitrogen but not nearly in proportion to it. The results obtained in this experiment would indicate that it is directly proportional to the total nitrogen elimination and, as stated by Burian and Schur and by Shaffer, it is for each individual a constant quantity. According to Burian and Schur, and Shaffer, it is a constant quantity when a purin free diet is used. In this experiment the diet contained meat, a fact which would affect the degree of constancy. As the quantity of meat was fairly constant, however, it might be expected that the uric acid excretion would remain fairly constant.

Undetermined Nitrogen.

The quantity of undetermined nitrogen per 24 hours (average for 208 days) varies from 0.108 grams (Subject 20, Table 35), to 0.590 grams (Subject 8, Table 59), The average for the twenty-four men is 0.426 grams. Per kilo body weight, the

variation is 0.0017 grams (Subject 20, Table 65), to 0.0086 grams (Subject 8, Table 59 and Subject 11, Table 65). The average for the whole squad is 0.0064 grams. The ratios of undetermined nitrogen to total urinary nitrogen range from 1.09% (Subject 20, Table 66), to 5.34% (Subject 10, Table 66). The average for the whole experiment is 3.95%. Per kilo body weight, the quantity is somewhat smaller than that given by Folin for normal urines, 0.0093 grams. As percent of total urinary nitrogen, Folin's ratio, 3.72%, is very similar to the 3.95% obtained here. There are no regular changes or variations in the amounts of undetermined nitrogen and no degree of constancy.

Conclusions.

Under normal conditions of health, diet and life, and when a moderate amount of physical and mental work are engaged in, the following facts concerning the metabolism of nitrogen in man are true:

(1) The daily amount of nitrogen ingested is 13.37 grams, (when the body weight is 66.1 kilos), or, for a body weight of 70 kilos, the daily ingested nitrogen is 14.14 grams. This corresponds to 88.37 grams of protein per day. Per kilo body weight the daily ingested nitrogen is 0.202 grams.

(2) (a) The average daily quantity of nitrogen excreted in the urine is 10.80 grams or 0.162 grams per kilo body weight.

(b) 80.91% of the daily ingested nitrogen is excreted in the urine.

(3) The chemical composition of the urine is as follows:

	Total per 24 hours (grams)	Per Kilo Body Weight, grams	Percent of Total Urinary Nitrogen
Total Urinary Nitrogen,	10.80		
Urea Nitrogen,	9.02	0.136	83.63
Ammonia Nitrogen,	0.449	0.0068	4.20
Creatinin Nitrogen,	0.690	0.104	6.49
Uric Acid Nitrogen,	0.187	0.0028	1.73
Undetermined Nitrogen,	0.426	0.0064	3.95

(4) The quantity of urea nitrogen is proportional to the total urinary nitrogen, except as the character of the urea excretion is changed by the seasons of the year.

(5) The quantities of creatinin and uric acid nitrogen eliminated are fairly constant and are proportional to the total urinary nitrogen.

TABLE 1. BODY WEIGHTS.

Averages, Maxima and Minima for Entire Experiment (208 days) Kilograms.

	Subject	8	9	12	16	17	19	Average
Group a	Average	68.6	63.6	67.5	63.0	70.6	65.4	66.5
	Maximum	69.7	65.6	69.3	63.7	71.4	66.6	
	Minimum.	66.6	62.5	64.8	61.6	70.2	63.6	
	Subject	1	3	4	6	7	14	
Group b	Average	71.0	56.5	79.7	70.2	69.7	53.7	66.9
	Maximum	72.2	57.5	81.3	71.2	70.7	54.9	
	Minimum.	68.9	55.6	77.8	69.5	68.5	51.3	
	Subject	2	15	18	21	22	23	
Group c	Average	80.6	64.6	73.1	58.4	63.6	55.8	66.0
	Maximum	82.8	68.1	74.2	58.9	66.0	56.9	
	Minimum	78.9	62.3	71.8	57.6	62.1	53.7	
	Subject	5	10	11	13	20	24	
Group d	Average	57.8	77.4	64.7	67.2	68.0	62.2	65.4
	Maximum	58.8	78.9	65.5	67.8	64.8	64.1	
	Minimum.	56.2	75.7	63.6	66.8	62.1	61.2	
						Grand Average		66.1

TABLE 2 Ingested Nitrogen for 24 hours. (16day periods) Grand Summary.

Period No.	Date	Group a gms	Group b gms	Group c gms	Group d gms	Average gms.
15-18	Jan. 4-19	14.42	14.32	15.40	13.83	14.49
19-22	" 20-F. 4	13.44	12.90	13.05	13.17	13.14
23-26	Feb. 5-20	13.04	12.83	13.02	12.84	12.93
27-30	F. 21-M. 7	13.73	12.69	13.09	13.20	13.18
31-34	Mar. 8-23	12.78	12.71	13.15	13.63	13.07
Average (80days)		13.41	13.14	13.53	13.52	13.40
35-38	M. 24-A. 8	12.98	12.94	13.32	13.58	13.20
39-42	Apr. 9-24	13.20	13.08	13.25	13.78	13.33
43-46	A. 25-M. 10	13.36	13.25	13.45	14.33	13.60
47-50	May 11-26	13.49	13.42	13.75	14.21	13.72
51-54	M. 27-J. 11	12.95	13.67	13.73	14.02	13.59
55-58	June 12-27	13.01	12.93	13.45	13.57	13.24
Average (96days)		13.29	13.14	13.44	13.87	13.43
59-62	J. 28-J. 13	13.04	12.65	13.27	13.55	13.13
63-66	July 14-29	12.97	12.40	13.16	13.61	13.03
Average (32days)		13.00	12.50	13.21	13.64	13.09
" (208 ")		13.30	13.04	13.44	13.70	13.37
Per Kilo Body Weight		0.200	0.195	0.204	0.210	0.202

URINARY NITROGEN.

TABLE 3 Total urinary nitrogen per 24 hours (16 day periods.) Grand Summary

Period No.	Date	Group a grams	Group b grams	Group c grams	Group d grams	Average grams.
15-18	Jan 4-19	11.82	10.95	11.38	10 94	11.27
19-22	J. 20-F. 4	1.88	11.14	11.44	11.40	11.46
23-26	Feb 5-20	9.27	10.46	10.90	10.76	10.35
27-30	F. 21-M. 7	10.60	10.14	10.44	11.14	10.58
31-34	Mar. 8-23	10.13	9.76	10 04	10 80	10 18
Average (80 days)		11.14	10.53	10.90	11.12	10 92
35-38	M. 24-A. 8	10.49	10.15	10 30	11.04	10.50
39-42	Apr. 9-24	10.62	10.49	10.24	10.91	10.57
43-46	A. 25-M. 10	10 96	10.69	11.15	11.87	11.17
47-50	May 11-26	11.50	11.17	11.36	12.10	11.53
51-54	M. 27-J. 11	11.14	11.38	10.96	11.64	11.28
55-58	June 12-27	10.86	10.11	10.82	10.98	10.69
Average (96 days)		10.98	10.65	10.84	11.34	10.95
59-62	J. 28-J. 13	10.21	9.64	10.33	10.68	10.21
63-66	July 14-29	10.18	9.58	10.53	10.55	10.21
Average (32 days)		10.20	9.61	10.43	10.61	10.21
Average (208 days)		10.92	10.44	10.80	11.14	10.80
Per Kilo body weight		0.164	0.157	0.163	0.171	0.162

TABLE 4. Per cent of Ingested Nitrogen Excreted in Urine (16 day Periods) Grand Summary.

Period No.	Date	Group a P.ct.	Group b P.ct.	Group c P.ct.	Group d P.ct.	Average P.ct.
15-18	J. 4-19	81.88	75.99	81.66	78.67	79.55
19-22	J. 20-F. 4	88.29	86.00	86.54	8686	86 92
23-26	Feb. 5-20	85.15	81.38	81.63	83.93	83 02
27-30	F. 21-M. 7	82.83	81.05	80.07	83.13	81.77
31-34	Mar. 8-23	79.43	76.73	76.74	79.53	78.11
Average (80 days)		83.41	80.18	80.70	81 97	81 54
35-38	M. 24-A. 8	80.69	78.41	77.42	81.32	79.46
39-42	Apr 9-24	80.66	80.19	77.19	79.27	79.33
43-46	A. 25-M 10	82.36	80.24	82.99	82.78	82.09
47-50	May 11-26	84.98	82.62	82.22	85.12	83.73
51-54	M. 27-J. 11	86.02	83.16	80.07	83.04	83 07
55-58	J. 12-27	83 99	78.37	80.44	80.97	80.87
Average (96 days)		82.51	80.45	79 87	82.02	81.21
59-62	J. 28-J. 13	78.87	76.20	77.84	79 56	73.12
63-66	July 14-29	79.19	76.16	80.46	78 48	78.62
Average (32 days)		79.03	76.62	79.15	78.80	78.40
Average (208 days)		82.33	79.76	80.08	81.51	80.91

URINARY NITROGEN.

TABLE 5 Urea Nitrogen for 24 hours (16 day periods) Grand Summary.

Period No.	Date	Group a grams	Group b Grams	Group c grams	Group d grams	Average grams.
15-18	Jan. 4-19	10.24	9.23	10.49	9.33	9.82
19-22	J. 20-F. 4	10.35	9.08	10.39	10.10	9.98
23-26	Feb. 5-20	9.28	8.66	8.96	8.93	8.96
27-30	F. 21-M. 7	9.45	8.47	8.82	9.27	9.00
31-34	Mar. 8-23	8.29	8.06	8.47	9.16	8.49
Average (80 days)		9.20	8.62	9.20	9.46	9.12
35-38	M. 24-A. 8	8.78	8.50	8.76	9.37	8.85
39-42	Apr. 9-24	8.76	8.70	8.55	9.10	8.78
43-46	A. 25-M. 10	9.37	8.67	9.46	10.21	9.42
47-50	May 11-26	9.62	9.15	9.48	10.06	9.58
51-54	M. 27-J. 11	9.23	9.39	9.08	9.78	9.37
55-58	J. 12-27	9.06	8.32	8.96	9.07	8.85
Average (96 days)		9.19	8.76	9.07	9.54	9.14
59-62	J. 28-J. 13	8.39	7.76	8.47	8.83	8.37
63-66	July 14-29	8.42	7.57	8.73	8.89	8.40
Average (32 days)		8.41	7.72	8.60	8.78	8.38
Average (208 days)		9.07	8.55	9.05	9.39	9.02
Per Kilo Body Weight.		0.136	0.128	0.137	0.144	0.136

TABLE 6. Percent of Urinary Nitrogen present as Urea. (16 day periods) Grand Summary

Period No	Date	Group a P.ct.	Group b P.ct.	Group c P.ct.	Group d P.ct.	Average P.ct.
15-18	Jan 4-19	82.63	80.41	84.09	82.52	82.54
19-22	J. 20-F. 4	83.80	82.26	85.05	85.76	84.23
23-26	Feb. 5-20	84.09	83.03	83.88	82.65	83.41
27-30	F. 21-M. 7	85.49	83.37	84.39	84.24	84.39
31-34	Mar. 8-23	82.67	82.45	83.78	85.14	83.51
Average (80 days)		84.80	83.22	84.40	85.05	84.49
35-38	M. 24-A. 8	83.93	83.72	84.95	84.54	84.28
39-42	Apr. 9-24	82.51	82.33	83.38	83.31	82.88
43-46	A. 25-M. 10	84.90	82.97	84.81	86.19	84.72
47-50	May 11-26	83.54	81.65	83.84	83.31	83.08
51-54	M. 27-J. 11	82.92	82.24	82.65	83.88	82.92
55-58	June 12-27	83.26	82.06	83.00	83.51	82.96
Average (96 days)		83.65	82.71	83.78	84.09	83.56
59-62	J. 28-J. 13	81.65	80.51	82.07	82.16	81.60
63-66	July 14-29	81.88	79.73	82.30	83.49	81.85
Average (32 days)		81.76	80.09	82.18	82.61	81.66
Average (208 days)		83.80	82.50	84.00	84.23	83.63

URINARY NITROGEN.

TABLE 7. Ammonia Nitrogen per 24 hours. (16 day periods) Grand Summary.

Period No.	Date	Group a grams	Group b grams	Group c grams	Group d grams	Average grams.
15-18	Jan. 4-19	0.523	0.531	0.421	0.425	0.475
19-22	J. 20 - F. 4	0.522	0.528	0.439	0.459	0.487
23-26	Feb. 5-20	0.475	0.503	0.451	0.416	0.461
27-30	F. 21 - M. 7	0.452	0.515	0.419	0.419	0.451
31-34	Mar. 8-23	0.462	0.508	0.415	0.403	0.447
Average (80 days)		0.476	0.499	0.428	0.418	0.455
35-38	M. 24 - A. 8	0.459	0.466	0.405	0.404	0.434
39-42	Apr. 9-24	0.453	0.489	0.410	0.406	0.439
43-46	A. 25 - M. 10	0.460	0.479	0.423	0.448	0.452
47-50	May 11-26	0.486	0.519	0.437	0.451	0.473
51-54	M. 27 - J. 11	0.436	0.516	0.424	0.421	0.449
55-58	June 12-27	0.440	0.474	0.439	0.416	0.442
Average (96 days)		0.459	0.479	0.430	0.418	0.446
59-62	J. 28 - J. 13	0.432	0.471	0.409	0.397	0.427
63-66	July 14-29	0.481	0.486	0.434	0.426	0.457
Average (32 days)		0.457	0.478	0.421	0.412	0.442
" (208 ")		0.465	0.487	0.428	0.417	0.449
Per Kilo Body weight.		0.0070	0.0072	0.0065	0.0064	0.0068

TABLE 8 Per cent of Total Urinary Nitrogen present as Ammonia (16 day periods) Grand Summary

Period No	Date	Group a p.ct.	Group b p.ct.	Group c p.ct.	Group d p.ct.	Average p.ct.
15-18	Jan. 4-19	4.23	4.75	3.35	3.88	4.05
19-22	J. 20 - F. 4	4.22	4.76	3.54	3.90	4.10
23-26	Feb. 5-20	4.32	4.83	4.33	3.86	4.33
27-30	F. 21 - M. 7	4.36	5.01	4.03	3.73	4.28
31-34	Mar. 8 - 23	4.63	5.20	4.18	3.70	4.43
Average (80 days)		4.39	4.89	4.04	3.76	4.27
35-38	M. 24 - A. 8	4.45	4.62	4.18	3.67	4.23
39-42	Apr. 9 - 24	4.29	4.65	4.05	3.74	4.18
43-46	A. 25 - M. 10	4.24	4.50	4.83	3.74	4.33
47-50	May 11 - 26	4.25	4.01	3.88	3.73	4.12
51-54	M. 27 - J. 11	3.96	4.52	3.93	3.59	4.00
55-58	June 12 - 27	4.08	4.64	4.11	3.76	4.15
Average (96 days)		4.22	4.54	3.96	3.69	4.10
59-62	J. 28 - J. 13	4.25	4.85	4.01	3.66	4.19
63-66	July 14-29	4.72	5.07	4.18	4.02	4.50
Average (32 days)		4.48	4.96	4.10	3.84	4.34
" (208 ")		4.32	4.74	4.01	3.74	4.20

URINARY NITROGEN.

TABLE 9 Creatinin Nitrogen per 24 hours. (16day periods) Grand Summary.

Period No	Date	Group a grams.	Group b grams	Group c grams	Group d grams	Average grams
15-18	Jan. 4-19	0.682	0.688	0.749	0.691	0.703
19-22	J. 20-F. 4	0.591	0.602	0.631	0.598	0.606
23-26	Feb. 5-20	0.683	0.694	0.654	0.698	0.682
27-30	F. 21-M. 7	0.656	0.687	0.695	0.679	0.679
31-34	Mar. 8-23	0.681	0.710	0.701	0.684	0.694
Average (80days)		0.664	0.692	0.683	0.677	0.679
35-38	M. 24-A. 8	0.674	0.699	0.675	0.685	0.683
39-42	Apr. 9-24	0.680	0.701	0.682	0.669	0.683
43-46	A. 25-M. 10	0.655	0.689	0.650	0.672	0.667
47-50	May 11-26	0.654	0.670	0.676	0.668	0.667
51-54	M. 27-J. 11	0.681	0.698	0.680	0.667	0.681
55-58	June 12-27	0.732	0.772	0.759	0.744	0.752
Average (96days)		0.674	0.703	0.691	0.674	0.687
59-62	J. 28-J. 13	0.744	0.772	0.774	0.757	0.762
63-66	J. 14-29	0.668	0.697	0.708	0.699	0.693
Average (32days)		0.706	0.735	0.741	0.729	0.728
" (208 ")		0.677	0.704	0.696	0.684	0.690
Per Kilo Body Weight		0.0102	0.0105	0.0105	0.0105	0.0104

TABLE 10. Per cent of Total Urinary Nitrogen present as Creatinin. (16day periods) Grand Summary.

Period No	Date	Group a p.ct.	Group b p.ct.	Group c p.ct.	Group d p.ct.	Average p.ct.
15-18	Jan. 4-19	5.53	6.36	5.96	6.11	5.99
19-22	J. 20-F. 4	4.79	5.58	5.11	5.07	5.14
23-26	Feb. 5-20	6.00	7.01	6.11	6.50	5.65
27-30	F. 21-M. 7	6.26	6.84	6.69	6.07	6.46
31-34	Mar. 8-23	6.84	7.35	6.93	6.39	6.88
Average (80 days)		6.16	6.80	6.59	6.09	6.41
35-38	M. 24-A. 8	6.50	7.00	6.58	6.24	6.58
39-42	Apr. 9-24	6.45	6.75	6.66	6.24	6.52
43-46	A. 24-M. 10	6.01	6.39	5.85	5.66	5.98
47-50	May 11-26	5.73	6.06	5.95	5.54	5.82
51-54	M. 27-J. 11	6.10	6.17	6.21	5.77	6.06
55-58	June 12-27	6.77	7.70	7.04	6.81	7.08
Average (96days)		6.28	6.72	6.31	6.10	6.35
59-62	J. 28-J. 13	7.33	8.10	7.48	7.03	7.48
63-66	July 14-29	6.50	7.26	6.63	6.76	6.79
Average (32days)		6.91	7.68	7.05	6.90	7.13
" (208 ")		6.33	6.90	6.53	6.22	6.49

URINARY NITROGEN.

TABLE 11. Uric Acid Nitrogen per 24 hours. (16day periods) Grand Summary.

Period No	Date	Group a grams	Group b grams	Group c grams	Group d grams	Average grams
15-18	Jan. 14-19	0.209	0.193	0.194	0.178	0.193
19-22	J. 20-F. 4	0.205	0.186	0.194	0.195	0.195
23-26	Feb. 5-20	0.202	0.186	0.191	0.204	0.196
27-30	F. 21-M. 7	0.197	0.192	0.192	0.184	0.193
31-34	Mar. 8-23	0.192	0.181	0.189	0.185	0.187
Average (80 days)		0.198	0.188	0.191	0.188	0.191
35-38	M. 24-A. 8	0.195	0.181	0.188	0.190	0.188
39-42	Apr. 9-24	0.178	0.182	0.176	0.173	0.177
43-46	A. 25-M. 10	0.193	0.183	0.187	0.182	0.186
47-50	May 11-26	0.196	0.189	0.187	0.179	0.188
51-54	M. 27-J. 11	0.188	0.192	0.183	0.176	0.185
55-58	June 12-27	0.194	0.181	0.197	0.175	0.187
Average (96 days)		0.188	0.183	0.187	0.177	0.184
59-62	J. 28-J. 13	0.188	0.177	0.193	0.178	0.184
63-66	July 14-29	0.194	0.174	0.191	0.169	0.182
Average (32 days)		0.191	0.175	0.192	0.174	0.183
" (208 ")		0.192	0.184	0.189	0.181	0.187
Per Kilo Body weight		0.0029	0.0028	0.0028	0.0028	0.0028

TABLE 12. Per cent of Total Urinary Nitrogen present as Uric Acid (16day periods) Grand Summary.

Period No.	Date	Group a p.ct.	Group b p.ct.	Group c p.ct.	Group d p.ct.	Average p.ct.
15-18	Jan. 14-19	1.70	1.76	1.54	1.57	1.64
19-22	J. 20-F. 4	1.66	1.69	1.57	1.65	1.64
23-26	Feb. 5-20	1.84	1.79	1.72	1.91	1.81
27-30	F. 21-M. 7	1.87	1.89	1.83	1.69	1.82
31-34	Mar. 8-23	1.90	1.86	1.87	1.72	1.84
Average (80 days)		1.82	1.82	1.79	1.69	1.78
35-38	M. 24-A. 8	1.87	1.78	1.83	1.72	1.80
39-42	Apr. 9-24	1.69	1.73	1.73	1.59	1.68
43-46	A. 25-M. 10	1.77	1.71	1.68	1.53	1.67
47-50	May 11-26	1.71	1.68	1.65	1.47	1.63
51-54	M. 27-J. 11	1.70	1.69	1.67	1.52	1.64
55-58	June 12-27	1.79	1.77	1.82	1.59	1.74
Average (96 days)		1.72	1.73	1.73	1.57	1.69
59-62	J. 28-J. 13	1.82	1.82	1.85	1.66	1.79
63-66	July 14-29	1.90	1.79	1.80	1.60	1.77
Average (32 days)		1.86	1.80	1.82	1.63	1.73
" (208 ")		1.78	1.78	1.74	1.62	1.73

URINARY NITROGEN.

TABLE 13. Undetermined Nitrogen per 24 hours (6day periods) Grand Summary.

Period No.	Date	Group a grams	Group b grams	Group c grams	Group d grams	Average grams.
15-18	Jan 4-9	0.719	0.580	0.668	0.691	0.664
19-22	J. 9-F. 4	0.681	0.614	0.581	0.508	0.596
23-26	Feb 5-20	0.408	0.403	0.406	0.509	0.432
27-30	F. 21-M. 7	0.283	0.282	0.328	0.472	0.341
31-34	Mar 8-23	0.374	0.291	0.259	0.218	0.293
Average (80 days)		0.326	0.344	0.341	0.388	0.350
35-38	M. 24-A 8	0.333	0.306	0.294	0.388	0.330
39-42	Apr. 9-24	0.551	0.426	0.430	0.549	0.489
43-46	A. 25-M. 7	0.329	0.471	0.412	0.402	0.403
47-50	May 11-26	0.550	0.652	0.514	0.664	0.596
51-54	M. 27-J. 11	0.556	0.567	0.594	0.603	0.580
55-58	June 12-27	0.440	0.385	0.458	0.471	0.439
Average (96 days)		0.436	0.456	0.445	0.517	0.463
59-62	J. 28-J 13	0.496	0.449	0.473	0.565	0.497
63-66	July 14-29	0.508	0.514	0.521	0.460	0.498
Average (32 days)		0.502	0.493	0.497	0.519	0.501
" (208 ")		0.464	0.469	0.466	0.468	0.426
Per Kilo Body Weight		0.0061	0.0063	0.0063	0.0072	0.0064

TABLE 14 Perct. of Total Urinary Nitrogen Present as Undetermined Nitrogen (6day Periods) Grand Summary

Period No.	Date	Group a p.ct.	Group b p.ct.	Group c p.ct.	Group d p.ct.	Average p.ct.
15-18	Jan 4-19	5.95	3.26	5.42	6.35	5.24
19-22	J. 20-F 4	5.70	5.68	4.71	4.32	5.10
23-26	Feb. 5-20	3.71	3.75	3.57	4.59	3.90
27-30	F. 21-M. 7	2.64	2.73	3.08	4.34	3.20
31-34	Mar. 8-23	3.76	2.78	2.79	2.34	2.92
Average (80 days)		3.27	3.00	3.11	3.33	3.18
35-38	M. 24-A. 8	3.12	2.73	3.16	3.72	3.18
39-42	Apr. 9-24	5.09	4.16	4.12	5.08	4.61
43-46	A. 25-M. 10	3.10	4.43	3.70	3.52	3.69
47-50	M. 11-26	4.84	6.09	4.63	4.97	5.13
51-54	M. 27-J. 11	4.81	5.12	5.47	5.21	5.15
55-58	June 12-27	4.08	3.91	4.08	4.46	4.28
Average (96 days)		3.97	4.33	4.10	4.63	4.26
59-62	J. 28-J. 13	4.65	4.65	4.53	5.29	4.78
63-66	July 14-29	5.02	5.56	4.92	4.33	4.96
Average (32 days)		4.90	5.16	4.70	4.94	4.92
" (208 ")		3.84	3.95	3.81	4.18	3.95

TABLE 15 INGESTED NITROGEN FOR 24 HOURS. (16 day periods) Group a

Period No	Subj. 8 gms	Subj. 9 gms	Subj. 12 gms	Subj. 16 gms	Subj. 17 gms.	Subj. 19 gms.
15-18	14.81	---	16.12	11.41	13.95	15.81
19-22	13.81	---	14.44	11.25	13.07	14.65
23-26	13.59	13.24	14.11	11.04	13.22	---
27-30	13.39	13.59	13.89	11.06	12.64	12.82
31-34	12.84	13.16	13.68	11.02	12.93	13.03
Av. (80 days)	13.80	13.33	14.62	11.14	13.27	14.28
35-38	12.99	---	14.02	11.52	13.03	13.32
39-42	13.33	13.30	13.95	11.81	---	13.60
43-46	13.52	---	14.39	11.67	13.52	13.69
47-50	13.62	13.92	14.58	11.64	13.71	---
51-54	13.59	13.92	---	11.63	---	12.65
55-58	13.65	13.65	---	11.45	13.50	12.30
Av. (96 days)	13.47	13.68	14.29	11.70	13.47	13.16
59-62	13.38	13.42	14.27	11.72	13.34	12.12
63-66	13.38	13.13	14.30	11.72	13.23	12.06
Av. (32 days)	13.38	13.27	14.28	11.72	13.28	12.09
" (208 ")	13.58	13.48	14.42	11.49	13.36	13.42
Per Kilo Body Wt.	0.198	0.212	0.214	0.182	0.189	0.206

TABLE 16 INGESTED NITROGEN FOR 24 HOURS. (16 day periods) Group b.

Period No.	Subj. 1 gms.	Subj. 3 gms.	Subj. 4 gms	Subj. 6 gms.	Subj. 7 gms	Subj. 14 gms.
15-18	15.60	13.95	17.50	---	13.33	11.23
19-22	14.38	12.53	15.66	11.43	12.37	11.02
23-26	14.01	12.17	15.29	12.13	12.16	11.20
27-30	13.70	12.12	15.20	12.06	11.98	11.02
31-34	13.64	---	15.08	12.15	11.91	10.79
Av. (80 days)	14.42	12.71	15.47	12.16	12.45	11.16
35-38	13.93	12.77	15.38	12.31	12.28	10.96
39-42	14.13	12.98	15.57	12.34	12.38	11.09
43-46	14.20	13.09	15.59	12.56	12.58	11.39
47-50	14.49	13.32	15.89	12.79	12.73	11.31
51-54	13.58	13.37	15.79	12.86	12.76	---
55-58	13.14	13.55	15.82	12.61	12.78	9.68
Av. (96 days)	13.93	13.18	15.68	12.58	12.58	10.89
59-62	12.82	12.76	15.63	12.61	12.50	9.56
63-66	---	11.87	15.61	12.49	12.50	9.53
Av. (32 days)	---	12.31	15.62	12.55	12.50	9.54
" (208 ")	14.04	12.87	15.78	12.41	12.52	10.79
Per Kilo Body Wt.	0.198	0.228	0.198	0.177	0.180	0.200

TABLE 17 INGESTED NITROGEN FOR 24 HOURS (16 day periods) Group C

Period No.	Subj. 2 gms.	Subj. 15 gms.	Subj. 18 gms.	Subj. 21 gms.	Subj. 22 gms.	Subj. 23 gms.
15-18	15.86	---	15.66	---	14.68	---
19-22	---	---	14.81	13.45	13.67	10.26
23-26	---	---	14.82	13.52	13.46	10.30
27-30	14.42	---	14.72	13.19	---	10.03
31-34	14.17	13.46	14.61	13.37	---	10.14
Av. (80 days)	14.94	13.52	14.98	13.65	13.86	10.25
35-38	14.35	13.69	14.87	13.62	13.05	10.37
39-42	14.29	13.60	14.77	13.54	13.01	10.32
43-46	---	14.01	15.24	13.88	13.45	10.66
47-50	---	14.39	15.50	14.21	13.78	10.88
51-54	14.98	14.33	15.47	12.94	13.76	10.93
55-58	14.72	14.08	15.16	12.35	13.54	10.81
Av. (96 days)	14.57	14.01	14.52	13.42	13.44	10.66
59-62	14.67	14.01	14.79	11.93	13.52	10.69
63-66	14.75	14.01	14.04	12.26	13.35	10.56
Av. (32 days)	14.71	14.01	14.41	12.09	13.43	10.62
" (208 ")	14.76	13.82	14.68	13.29	13.55	10.52
Per Kilo Body Wt.	0.183	0.214	0.200	0.228	0.213	0.189

TABLE 18 INGESTED NITROGEN FOR 24 HOURS (16 day periods) Group A.

Period No.	Subj. 5 gms.	Subj. 10 gms.	Subj. 11 gms.	Subj. 13 gms.	Subj. 20 gms.	Subj. 24 gms.
15-18	14.15	14.38	15.36	---	11.44	---
19-22	13.76	---	14.41	13.24	11.29	---
23-26	13.08	---	14.14	13.02	11.14	---
27-30	12.85	13.61	13.59	13.08	12.86	---
31-34	13.03	13.80	13.77	13.26	13.41	14.03
Av. (80 days)	13.41	14.07	14.36	13.22	12.08	14.00
35-38	12.64	13.79	13.81	13.34	13.10	14.00
39-42	12.91	14.03	14.09	13.59	---	14.27
43-46	---	14.34	14.42	13.91	---	14.66
47-50	13.37	14.48	14.35	13.99	---	14.84
51-54	12.39	14.70	13.72	14.27	---	15.01
55-58	11.83	14.31	13.25	13.81	---	14.64
Av. (96 days)	12.68	14.28	13.97	13.82	---	14.58
59-62	11.77	14.40	13.06	13.86	---	14.66
63-66	11.66	14.37	---	13.74	---	14.66
Av. (32 days)	11.71	14.38	---	13.80	---	14.66
" (208 ")	12.81	14.21	14.06	13.59	12.38	14.37
Per Kilo Body Wt.	0.222	0.184	0.217	0.202	0.196	0.231

URINARY NITROGEN.

TABLE 19 Total Urinary Nitrogen per 24 hours (4 day periods) Summary Group a

Period No	Subject 8 grams	Subject 9 grams	Subject 12 grams	Subject 16 grams	Subject 17 grams	Subject 19 grams
15-18	11.93	----	12.76	9.24	11.54	13.62
19-22	11.89	----	12.79	9.60	11.99	13.14
23-26	11.67	11.89	11.94	8.93	11.20	----
27-30	11.28	11.21	11.26	8.77	10.67	10.41
31-34	10.60	10.65	10.80	8.18	10.66	9.86
Av. (80 days)	11.50	11.24	11.92	8.97	11.27	11.95
35-38	11.05	----	11.49	8.80	10.16	10.98
39-42	10.66	9.68	11.68	9.43	----	11.63
43-46	11.40	10.70	12.01	9.38	10.90	11.35
47-50	11.40	11.75	12.62	10.21	11.35	11.65
51-54	11.83	11.97	---	9.89	----	10.88
55-58	11.18	11.60	---	10.01	11.03	10.48
Av. (96 days)	11.25	11.14	11.81	9.62	10.89	11.16
59-62	10.95	10.97	10.30	9.86	9.66	9.50
63-66	10.65	10.31	10.78	9.23	10.21	9.88
Av. (32 days)	10.80	10.64	10.54	9.44	9.69	10.20
" (208 ")	11.28	11.11	11.66	9.36	10.90	11.31
Per Kilo Body Wt.	0.164	0.174	0.173	0.149	0.154	0.173

TABLE 20 Percent of Ingested Nitrogen Excreted in Urine (16 day periods) Summary Group a

Period No	Subject 8 p.ct.	Subject 9 p.ct.	Subject 12 p.ct.	Subject 16 p.ct.	Subject 17 p.ct.	Subject 19 p.ct.
15-18	80.54	----	79.11	80.89	82.74	86.13
19-22	86.14	----	88.56	85.37	91.71	89.66
23-26	85.83	89.74	84.01	83.79	84.81	----
27-30	84.29	84.86	81.16	79.30	84.27	83.11
31-34	82.57	82.81	78.89	74.14	82.47	75.73
Av. (80 days)	83.34	85.81	81.55	80.06	85.07	84.05
35-38	84.54	----	82.03	76.41	77.97	82.50
39-42	79.98	74.27	83.75	79.79	----	85.53
43-46	84.35	----	83.46	80.53	80.57	82.87
47-50	83.68	84.41	86.46	87.65	82.78	---
51-54	87.04	85.99	----	85.08	----	85.96
55-58	81.88	87.34	----	83.76	81.08	85.27
Av (96 days)	83.20	81.63	82.80	82.21	80.73	84.52
59-62	81.78	81.73	72.11	84.15	72.38	81.07
63-66	79.59	82.31	75.37	78.84	77.10	81.93
Av. (32 days)	80.68	82.02	73.74	81.49	74.74	81.50
" (208 ")	82.87	83.30	80.58	81.50	81.61	83.87

URINARY NITROGEN.

TABLE 21 Total Urinary Nitrogen for 24 Hours (4 day periods) Group D.

Period No.	Subj. 1. gms.	Subj. 3 gms.	Subj. 4 gms.	Subj. 6 gms.	Subj. 7 gms.	Subj. 14 gms.
15-18	12.51	10.94	14.08	10.83	8.90	8.45
19-22	13.16	11.06	13.88	9.97	9.55	9.19
23-26	11.82	10.10	12.70	9.44	9.65	9.00
27-30	11.47	10.36	11.72	9.77	8.93	8.59
31-34	11.25	---	11.31	9.21	8.23	8.78
Av. (80 days)	12.13	10.58	12.77	9.91	9.10	8.71
35-38	11.81	8.75	12.37	9.69	8.36	8.44
39-42	12.27	10.50	11.99	10.07	9.22	8.91
43-47	12.22	10.45	12.47	9.62	10.12	9.23
47-50	12.84	10.95	13.47	10.16	10.74	8.88
51-54	11.77	11.13	13.32	10.65	10.05	---
55-58	10.94	10.56	12.38	9.65	9.89	7.26
Av. (96 days)	11.90	11.01	12.67	9.97	9.73	8.64
59-62	10.53	10.18	11.59	9.24	9.04	7.24
63-66	10.32	9.55	11.65	9.36	9.44	7.18
Av. (32 days)	10.43	9.86	11.62	9.30	9.24	7.21
" (208 ")	11.76	10.67	12.55	9.85	9.41	8.39
Per Kilo Body Wt.	0.165	0.189	0.158	0.140	0.135	0.156

TABLE 22 Per cent of Total Urinary Nitrogen Excreted in Urine. (4 day periods) Group D

Period No.	Subj. 1 p.ct.	Subj. 3 p.ct.	Subj. 4 p.ct.	Subj. 6 p.ct.	Subj. 7 p.ct.	Subj. 14 p.ct.
15-18	76.27	81.30	80.43	---	66.72	75.21
19-22	91.44	88.31	88.62	87.16	77.16	83.34
23-26	84.28	83.01	83.08	77.74	79.64	80.55
27-30	83.77	85.54	77.16	87.07	74.76	78.01
31-34	82.50	---	75.06	75.72	68.99	81.39
Av. (80 days)	83.52	83.62	79.97	82.08	73.56	78.33
35-38	84.77	76.46	80.54	78.66	68.35	81.70
39-42	86.87	80.91	77.00	81.56	74.49	80.30
43-46	85.46	77.90	80.08	76.54	80.43	81.03
47-50	88.57	79.64	84.81	79.80	84.35	78.53
51-54	86.73	83.23	84.32	82.84	78.69	---
55-58	83.29	77.90	78.25	78.46	77.38	74.96
Av. (96 days)	85.95	79.35	80.84	79.61	77.28	79.68
59-62	82.10	79.92	74.11	73.29	72.04	75.73
63-66	---	80.40	74.62	74.95	75.49	75.32
Av. (32 days)	81.80	80.16	74.36	74.12	73.76	75.52
" (208 ")	84.38	81.12	79.51	79.72	75.31	78.52

URINARY NITROGEN.

TABLE 23 Total Urinary Nitrogen for 24 Hours (16 day periods) Group C

Period No.	Subj. 2 gms.	Subj. 15 gms.	Subj. 18 gms.	Subj. 21 gms.	Subj. 22 gms.	Subj. 23 gms.
15-18	12.80	---	12.00	11.79	12.77	8.52
19-22	---	---	12.04	11.67	12.69	8.74
23-26	---	---	11.76	12.41	11.34	8.09
27-30	10.68	---	11.63	11.20	---	8.24
31-34	10.77	10.14	10.61	10.30	---	8.39
Av. (80 days)	11.74	10.26	11.73	11.29	12.00	8.40
35-38	11.00	10.67	10.45	11.02	9.97	8.19
39-42	10.95	10.36	11.07	10.73	9.98	8.37
43-46	---	11.57	12.43	11.72	11.08	8.96
47-50	11.73	11.54	12.49	11.55	11.62	9.24
51-54	11.58	11.43	11.91	10.83	11.15	8.86
55-58	11.51	11.02	12.17	10.28	11.32	8.61
Av. (96 days)	11.44	11.10	11.84	11.10	10.85	8.71
59-62	11.56	11.32	10.57	9.60	10.62	8.30
63-66	11.35	11.26	11.49	9.43	10.65	8.49
Av. (32 days)	11.45	11.29	11.03	9.76	10.03	8.39
" (208 ")	11.56	10.81	11.67	10.47	10.48	8.54
Per Kilo Body Wt.	0.143	0.168	0.159	0.188	0.165	0.153

TABLE 24 Percent of Ingested Nitrogen Excreted in Urine (16 day periods) Group C

Period No	Subj. 2 p.ct.	Subj. 15 p.ct.	Subj. 18 p.ct.	Subj. 21 p.ct.	Subj. 22 p.ct.	Subj. 23 p.ct.
15-18	80.74	---	77.32	---	86.92	---
19-22	---	---	81.39	86.77	92.79	85.22
23-26	---	---	79.33	84.44	84.27	78.50
27-30	74.10	---	79.00	85.07	---	82.12
31-34	76.04	75.37	72.59	77.13	---	82.54
Av. (80 days)	78.98	75.94	78.58	82.84	86.07	81.77
35-38	76.61	77.45	73.67	80.92	76.37	78.99
39-42	76.61	76.17	74.91	71.29	75.14	81.01
43-46	---	82.61	81.54	84.41	82.41	83.99
47-50	---	80.16	80.54	81.26	84.20	84.89
51-54	77.28	79.78	76.95	83.71	81.02	81.07
55-58	78.22	78.27	80.12	83.12	83.25	79.69
Av. (96 days)	77.69	77.97	82.12	80.70	81.61	79.87
59-62	78.77	80.68	71.46	80.02	78.50	77.02
63-66	77.41	80.33	81.86	81.01	81.79	80.39
Av. (32 days)	78.09	80.50	76.66	80.51	80.14	79.00
" (208 ")	78.25	78.13	78.00	82.15	82.08	81.27

URINARY NITROGEN.

TABLE 25 Total urinary Nitrogen for 24 hours (4 day periods) Group 4.

Period No.	Subj. 5 gms.	Subj 10 gms.	Subj. 11 gms.	Subj. 13 gms.	Subj. 20 gms.	Subj. 24 gms.
15-18	10.88	11.40	11.62	11.20	9.56	---
19-22	11.83	---	11.73	11.59	10.45	---
23-26	10.93	---	11.06	12.51	9.52	---
27-30	10.66	10.10	11.46	11.46	10.81	12.32
31-34	10.26	10.48	10.27	10.75	11.57	11.49
Av (80 days)	10.92	11.11	11.25	11.24	10.27	11.91
35-38	10.98	10.81	10.27	11.01	11.62	11.55
39-42	10.86	10.71	10.52	10.80	---	11.08
43-46	---	11.50	11.89	11.84	---	12.26
47-50	11.85	11.99	12.28	12.07	---	12.24
51-54	10.56	11.43	11.20	11.47	---	13.02
55-58	10.05	10.92	10.37	11.14	---	12.43
Av. (96 days)	10.84	11.31	11.09	11.39	---	12.05
59-62	9.42	10.75	10.13	11.57	---	11.51
63-66	9.50	10.79	10.13	10.97	---	11.35
Av (32 days)	9.46	10.77	10.13	11.27	---	11.43
" (208 ")	10.66	11.15	11.00	11.31	10.44	11.90
Per Kilo Body Wt.	0.184	0.144	0.170	0.169	0.166	0.191

TABLE 26 Percent of Ingested Nitrogen excreted in urine (4 day periods) Group 4.

15-18	76.89	78.38	75.83	---	83.59	---
19-22	85.98	---	81.38	87.54	92.54	---
23-26	83.59	---	78.17	88.30	85.66	---
27-30	82.97	76.55	84.30	87.75	84.10	---
31-34	80.52	75.98	74.60	81.01	83.16	81.92
Av. (80 days)	81.60	78.14	78.67	85.62	85.26	82.52
35-38	86.77	78.30	74.34	82.51	83.56	82.45
39-42	84.11	76.34	74.64	74.47	---	81.79
43-46	---	80.11	82.41	85.11	---	83.50
47-50	88.60	82.78	84.12	86.23	---	83.85
51-54	85.08	81.15	81.54	80.32	---	87.10
55-58	84.42	76.25	78.24	80.57	---	84.87
Av. (96 days)	85.45	79.10	79.22	82.37	---	83.41
59-62	80.06	74.63	79.34	84.94	---	78.82
63-66	81.44	75.26	---	79.82	---	77.42
Av (32 days)	80.75	74.94	77.83	82.38	---	78.12
" (208 ")	83.25	78.12	78.80	83.62	84.98	82.48

URINARY NITROGEN

TABLE 27 Urea Nitrogen per 24 hours (16 day periods) Summary Group a.

Period No.	Subj. 8 grams	Subj. 9 grams	Subj. 12 grams	Subj. 16 grams	Subj. 17 grams	Subj. 19 grams.
15-18	9.90	- - - -	- - - -	- - - -	9.32	11.49
19-22	9.95	- - - -	- - - -	- - - -	10.14	10.96
23-26	9.63	10.13	10.31	7.24	9.07	- - - -
27-30	9.43	10.56	9.95	- - - -	8.77	8.52
31-34	8.64	- - - -	9.29	6.62	8.58	8.31
Av. (80 days)	8.55	10.38	9.85	7.05	9.30	10.09
35-38	9.31	- - - -	9.66	6.93	8.50	9.51
39-42	8.98	8.26	9.39	7.44	- - - -	9.71
43-46	9.68	- - - -	10.39	7.73	9.28	9.77
47-50	9.57	9.85	10.91	8.22	9.53	- - -
51-54	9.87	9.87	- - -	8.23	- - -	8.93
55-58	9.17	10.12	- - -	8.09	9.22	8.69
Av. (96 days)	9.43	9.47	10.01	7.76	9.06	9.40
59-62	9.00	9.36	8.21	7.90	7.87	8.03
63-66	8.88	9.06	8.94	7.18	8.26	8.20
Av. (32 days)	8.94	9.21	8.57	7.54	8.06	8.12
" (208 ")	9.02	9.78	9.73	7.46	9.00	9.47
Per Kilo Body wt.	0.131	0.154	0.144	0.118	0.127	0.145

TABLE 28 Per cent of Total Urinary Nitrogen present as Urea (16 day periods) Group a

Period	Subj. 8 p.ct.	Subj. 9 p.ct.	Subj. 12 p.ct.	Subj. 16 p.ct.	Subj. 17 p.ct.	Subj. 19 p.ct.
15-18	82.96	- - -	- - -	- - -	80.67	82.63
19-22	83.67	- - -	- - -	- - -	84.53	83.38
23-26	82.55	89.39	86.33	81.16	81.01	- - -
27-30	83.66	91.50	88.32	- - -	82.17	81.80
31-34	81.43	- - -	86.08	80.98	80.56	84.28
Av. (80 days)	82.91	91.67	86.90	81.67	81.75	83.88
35-38	86.22	- - -	84.28	79.06	83.51	86.59
39-42	84.23	85.31	80.32	78.89	- - -	83.81
43-46	84.87	- - -	86.51	82.37	84.72	86.03
47-50	83.96	83.93	86.44	80.80	82.58	- - -
51-54	83.80	82.54	- - -	83.19	- - -	82.15
55-58	81.96	87.24	- - -	80.74	83.56	82.82
Av. (96 days)	84.18	85.21	84.59	80.85	83.43	- - -
59-62	82.14	84.89	79.71	80.01	81.43	81.75
63-66	83.23	83.68	82.94	77.60	80.88	82.96
Av. (32 days)	82.68	84.28	81.32	78.80	81.15	82.35
" (208 ")	83.46	87.55	84.98	80.85	82.43	83.81

URINARY NITROGEN.

TABLE 29 Urea Nitrogen for 24 Hours (16 day periods) Group D.

Period No	Subj. 1 gms	Subj. 3 gms	Subj. 4 gms.	Subj. 6 gms	Subj. 7 gms.	Subj. 14 gms.
15-18	---	---	11.92	---	---	6.53
19-22	---	---	11.58	8.33	---	7.34
23-26	9.69	8.73	10.35	7.80	8.03	7.37
27-30	9.33	9.11	9.70	8.09	7.62	7.00
31-34	9.27	---	9.16	7.75	6.73	7.88
Av. (80 days)	9.43	8.88	10.54	8.31	7.47	7.07
35-38	9.75	8.43	10.41	8.06	6.78	7.57
39-42	10.50	8.69	10.02	8.29	7.24	7.44
43-46	10.17	8.79	10.43	7.87	8.17	6.56
47-50	10.52	8.91	11.20	8.14	8.84	7.27
51-54	9.64	9.28	11.40	8.64	7.96	---
55-58	8.98	8.88	10.28	7.87	7.81	6.08
Av. (96 days)	9.93	8.83	10.62	8.15	7.80	7.24
59-62	8.32	8.49	9.33	7.45	7.12	5.87
63-66	---	7.77	9.45	7.39	7.57	5.68
Av. (32 days)	8.28	8.13	9.39	7.42	7.35	5.78
" (208 ")	9.48	8.74	10.40	8.10	7.60	6.95
Per Kilo Body Wt.	0.133	0.157	0.130	0.115	0.109	0.129

TABLE 30 Per cent of Total Urinary Nitrogen present as Urea (16 day periods) Group D.

Period No	Subj. 1 p.ct.	Subj. 3 p.ct	Subj. 4 p.ct	Subj. 6 p.ct	Subj. 7 p.ct	Subj. 14 p.ct.
15-18	---	---	84.50	---	---	77.33
19-22	---	---	83.36	83.53	---	79.90
23-26	81.91	86.43	82.01	82.68	83.25	81.89
27-30	81.28	87.95	81.57	82.73	85.25	81.47
31-34	82.44	---	80.92	82.59	82.18	84.11
Av. (80 days)	81.88	87.85	82.04	82.97	83.56	81.00
35-38	82.50	86.39	84.13	83.18	81.20	84.93
39-42	83.51	82.70	83.57	82.26	78.43	83.49
43-46	83.12	84.17	83.55	81.75	80.69	84.52
47-50	81.81	81.35	83.06	79.82	82.19	81.66
51-54	81.95	83.39	85.50	81.14	79.22	---
55-58	82.03	84.08	82.93	80.62	79.02	83.67
Av. (96 days)	83.33	83.68	83 83	81.47	80.3	83.82
59-62	78.98	83.40	80.52	80.51	78.67	80.96
63-66	---	81 45	80.67	78.45	78.57	79.02
Av. (32 days)	79.20	82.42	80.59	79.73	78.62	79.99
" (208 ")	82.18	85.10	82.64	81.78	81.22	82.15

URINARY NITROGEN.

TABLE 31 Urea Nitrogen for 24 Hours (16day periods) Group C

Period No.	Subj. 2 gms	Subj. 15 gms	Subj. 18 gms	Subj. 21 gms	Subj. 22 gms	Subj. 23 gms
15-18	10.62	---	10.21	---	10.63	---
19-22	---	---	10.33	---	10.46	---
23-26	---	---	9.88	9.41	9.32	6.75
27-30	8.76	---	9.88	9.74	---	6.91
31-34	8.74	8.88	8.92	8.75	---	7.08
Av. (80days)	9.75	9.12	9.98	9.46	9.99	6.91
35-38	9.27	9.15	9.26	9.50	8.47	6.88
39-42	9.27	8.53	9.04	9.07	8.73	6.66
43-46	---	9.48	10.58	10.28	9.37	7.57
47-50	---	9.62	10.60	9.68	10.03	7.48
51-54	9.70	9.32	9.79	9.07	9.41	7.17
55-58	9.48	9.06	10.05	8.73	9.45	7.01
Av. (96days)	9.61	9.18	9.88	9.39	9.24	7.13
59-62	9.58	9.16	8.55	8.01	8.76	6.78
63-66	9.44	9.36	9.67	8.16	8.94	6.81
Av (32days)	9.51	9.26	9.11	8.09	8.85	6.80
" (208 ")	9.65	9.17	9.81	9.22	9.51	7.00
Per Kilo Body Wt.	0.120	0.142	0.134	0.158	0.149	0.128

TABLE 32 Percent of Total Urinary Nitrogen present as Urea. (16day periods) Group C

Period No.	Subj 2 p.ct.	Subj. 15 p.ct.	Subj. 18 p.ct.	Subj. 21 p.ct.	Subj 22 p.ct.	Subj 23 p.ct.
15-18	82.93	---	85.83	---	83.52	---
19-22	---	---	85.74	---	84.37	---
23-26	---	---	83.17	86.79	82.15	83.42
27-30	81.99	---	84.82	86.90	---	83.86
31-34	81.17	84.54	84.09	84.64	---	84.44
Av. (80 days)	82.61	88.86	84.56	86.12	83.37	83.91
35-38	84.30	85.72	84.41	86.38	84.45	83.96
39-42	84.67	82.32	81.66	84.49	87.50	79.62
43-46	---	81.96	85.03	87.77	84.75	84.52
47-50	---	83.28	84.87	83.77	86.31	80.95
51-54	83.71	81.50	82.22	83.68	83.85	80.97
55-58	82.39	82.19	82.50	85.96	83.54	81.48
Av (96days)	84.21	82.83	83.45	85.18	85.12	81.91
59-62	82.82	80.90	80.88	83.42	82.61	81.78
63-66	83.17	83.04	84.08	82.14	80.95	80.45
Av. (32days)	82.99	81.97	82.48	82.78	81.78	81.11
" (208 ")	83.41	85.02	83.73	85.16	83.93	82.55

URINARY NITROGEN.

TABLE 33 Urea Nitrogen for 24 Hours (16day periods) Group G1.

Period No	Subj. 5 gms.	Subj. 10 gms.	Subj. 11 gms.	Subj. 13 gms.	Subj. 20 gms.	Subj. 24 gms.
15-18	9.18	9.31	9.50	---	---	---
19-22	10.18	---	10.01	---	---	---
23-26	9.08	---	8.92	9.54	8.19	---
27-30	8.78	8.81	9.45	9.91	9.37	---
31-34	7.88	8.76	8.48	9.19	10.30	10.33
Av.(80days)	9.09	9.14	9.31	9.56	9.28	10.40
35-38	9.24	9.12	8.31	9.37	10.16	10.00
39-42	9.23	8.97	8.68	8.77	---	9.88
43-46	---	9.87	10.35	10.00	---	10.62
47-50	9.45	10.03	10.36	9.78	---	10.20
51-54	8.91	10.03	9.39	9.55	---	10.12
55-58	8.50	8.47	8.40	9.17	---	10.79
Av.(96days)	9.19	9.41	9.25	9.44	---	10.42
59-62	7.67	8.85	8.49	9.49	---	9.65
63-66	8.06	9.10	---	8.91	---	9.49
Av(32days)	7.87	8.98	8.27	9.20	---	9.57
" (208 ")	8.95	9.24	9.12	9.45	9.44	10.28
Period Body Wt.	0.155	0.119	0.141	0.140	0.150	0.165

TABLE 34 Percent of Total Urinary Nitrogen present as urea (16day period... Group 4

Period No	Subj. 5 p.ct.	Subj. 10 p.ct.	Subj. 11 p.ct.	Subj. 13 p.ct.	Subj. 20 p.ct.	Subj. 24 p.ct.
15-18	84.35	81.68	81.54	---	---	---
19-22	86.05	---	85.48	---	---	---
23-26	83.12	---	78.82	82.91	85.73	---
27-30	82.36	83.04	82.37	86.80	86.03	---
31-34	80.38	83.59	82.47	85.58	89.01	89.83
Av.(80days)	83.42	82.80	81.43	85.11	87.13	89.91
35-38	83.92	84.10	85.79	85.17	86.64	86.05
39-42	84.79	83.09	82.38	81.13	---	84.56
43-46	---	86.76	87.06	84.43	---	86.51
47-50	84.04	83.67	84.87	80.49	---	82.48
51-54	84.39	83.98	83.78	82.86	---	84.37
55-58	85.86	82.09	80.50	82.30	---	86.80
Av.(96days)	84.87	83.89	83.54	82.82	---	85.32
59-62	81.34	82.12	81.86	82.01	---	83.48
63-66	84.83	84.31	---	81.16	---	83.61
Av(32days)	83.08	83.21	81.63	81.58	---	82.56
" (208 ")	84.04	83.37	82.63	83.51	87.05	86.81

URINARY NITROGEN.

TABLE 35 Ammonia Nitrogen for 24 Hours. (16 day periods) Summary. Group a.

Period No.	Subj. 8 gms.	Subj. 9. gms.	Subj. 12 gms.	Subj. 16. gms.	Subj. 17 gms.	Subj. 19 gms.
15-18	0.477	- - -	- - -	- - -	0.514	0.577
19-22	0.464	- - -	- - -	- - -	0534	0.568
23-26	0.471	0.438	0.490	0.471	0.507	- - -
27-30	0.419	0.422	- - -	0.454	0.463	0.502
31-34	0.413	0.455	0.472	0.506	0.458	0.471
Ar. (80 days)	0.445	0.439	0.474	0477	0.490	0530
35-38	0.400	- - -	0.480	0.491	0.433	0.489
39-42	0.389	0.413	0.448	0.506	- - -	0.508
43-46	0.405	0.415	0.481	0.503	0.447	0.509
47-50	0.420	0.483	0.514	0.507	0.492	0.497
51-54	0.418	0.394	- - -	0.456	- - -	0.476
55-58	0.398	0.365	- - -	0.487	0.469	0.480
Ar. (96 days)	0.405	0.414	0.480	0.492	0.469	0.493
59-62	0.431	0.325	0.463	0.480	0.470	0.425
63-66	0.416	0.415	0.497	0.525	0534	0.499
Ar. (32 days)	0.423	0.370	0.480	0.502	0502	0.462
" (208 ")	0.423	0.385	0.478	0.488	0.482	0502
Per Kilo Body Wt.	0.0062	0.0061	0 0071	0.0077	0.0068	0.0077

TABLE 36 Percent of Total Urinary Nitrogen present as Ammonia (16 day periods) Group a.

Period No.	Subj. 8 p.ct.	Subj. 9 p.ct.	Subj. 12 p.ct.	Subj. 16 p.ct.	Subj. 17 p.ct.	Subj. 19 p.ct.
15-18	3.99	- - -	- - -	- - -	4.47	4.24
19-22	3.90	- - -	- - -	- - -	4.44	4.33
23-26	4.03	3.69	4.10	5.27	4.53	- - -
27-30	3.72	3.85	- - -	5.18	434	4.71
31-34	3.89	4.27	4.37	6.22	4.28	4.77
Ar. (80 days)	3.87	3.94	4.18	5.56	4.35	4.45
35-38	3.62	- - -	4.18	5.74	4.27	4.46
39-42	3.65	4.26	3.84	5.36	- - -	4.35
43-46	3.56	3.88	4.01	5.38	4.12	4.49
47-50	3.69	4.13	4.09	4.98	4.35	4.28
51-54	3.54	3.31	- - -	4.61	- - -	4.37
55-58	3.55	3.15	- - -	4.86	4.27	4.56
Ar. (96 days)	3.60	3.75	4.07	5.15	4.32	4.42
59-62	3.93	2.97	4.49	4.85	4.86	4.41
63-66	3.92	3.84	4.61	5.69	5.23	5.04
Ar. (32 days)	3.92	3.40	4.55	5.27	5.04	4.72
" (208 ")	3.75	3.77	4.19	5.33	4.44	4.48

URINARY NITROGEN

TABLE 37 Ammonia Nitrogen for 24 hours (4 day periods) Group D.

Period No.	Subj. 1 gms.	Subj. 3 gms.	Subj. 4 gms.	Subj. 6 gms.	Subj. 7 gms.	Subj. 14 gms.
15-18	---	---	0.723	0.472	---	0.399
19-22	---	---	0.695	0.472	---	0.417
23-26	0.598	0.453	0.666	0.426	0.487	0.388
27-30	0.589	0.463	0.701	0.466	0.478	0.395
31-34	0.569	---	0.634	0.454	0.486	0.399
Avr. (80 days)	0.585	0.459	0.622	0.449	0.484	0.397
35-38	0.536	0.434	0.573	0.412	0.478	0.365
39-42	0.571	0.465	0.587	0.466	0.498	0.348
43-46	0.545	0.433	0.646	0.433	0.445	0.369
47-50	0.598	0.498	0.688	0.473	0.513	0.346
51-54	0.523	0.495	0.656	0.450	0.458	---
55-58	0.496	0.469	0.595	0.466	0.526	0.295
Avr. (96 days)	0.499	0.467	0.624	0.450	0.486	0.345
59-62	0.504	0.445	0.640	0.407	0.494	0.334
63-66	0.513	0.478	0.673	0.453	0.493	0.327
Avr. (32 days)	0.509	0.451	0.656	0.430	0.493	0.331
" (208 ")	0.534	0.462	0.629	0.454	0.487	0.363
Per Kilo Body Wt.	0.0075	0.0082	0.0065	0.0065	0.0070	0.0068

TABLE 38 Percent of Total Urinary Nitrogen present as Ammonia (4 day periods) Group D.

Period No.	Subj. 1 p.ct.	Subj. 3 p.ct.	Subj. 4 p.ct.	Subj. 6 p.ct.	Subj. 7 p.ct.	Subj. 14 p.ct.
15-18	---	---	5.14	4.39	---	4.73
19-22	---	---	5.00	4.73	---	4.54
23-26	5.06	4.48	5.24	---	5.06	4.31
27-30	4.90	4.46	5.98	4.76	5.36	4.59
31-34	5.05	---	5.60	4.92	5.88	4.54
Avr (80 days)	5.01	4.54	5.39	4.57	5.27	4.56
35-38	4.54	4.46	4.64	4.26	5.71	4.04
39-42	4.64	4.43	4.91	4.64	5.41	3.88
43-46	4.45	4.21	5.43	4.50	4.40	3.49
47-50	4.66	4.56	5.12	4.66	4.79	3.87
51-54	4.44	4.44	4.42	4.22	4.56	---
55-58	4.53	4.44	4.79	4.70	5.30	4.06
Avr. (96 days)	4.55	4.08	4.41	4.50	5.03	4.18
59-62	4.73	4.37	5.53	4.38	5.46	4.61
63-66	4.97	4.80	5.77	5.11	5.21	4.55
Avr. (32 days)	4.85	4.58	5.65	4.74	5.33	4.58
" (208 ")	4.77	4.33	5.21	4.56	5.17	4.39

URINARY NITROGEN

TABLE 39 Ammonia Nitrogen for 24 Hours (16 day periods) Group C

Period No	Subj. 2 gms.	Subj. 15 gms	Subj 18 gms	Subj. 21 gms	Subj. 22 gms.	Subj. 23 gms
15-18	0.400	---	0.399	---	0.464	---
19-22	---	---	0.399	---	0.479	---
23-26	---	---	0.412	0.489	0.454	0.451
27-30	0.367	0.391	0.408	0.491	---	0.436
31-34	0.377	0.413	0.399	0.449	---	0.435
Av. (80 days)	0.391	0.402	0.402	0.476	0.457	0.440
35-38	0.359	0.406	0.404	0.476	0.363	0.422
39-42	0.385	0.397	0.383	0.477	0.380	0.440
43-46	---	0.460	0.366	0.483	0.399	0.409
47-50	0.362	0.469	0.434	0.509	0.421	0.424
51-54	0.360	0.455	0.378	0.484	0.414	0.455
55-58	0.425	0.458	0.446	0.448	0.421	0.435
Av. (96 days)	0.375	0.442	0.453	0.480	0.400	0.431
59-62	0.388	0.427	0.434	0.428	0.387	0.387
63-66	0.417	0.440	0.378	0.470	0.459	0.442
Av. (32 days)	0.403	0.433	0.406	0.449	0.423	0.414
" (208 ")	0.385	0.425	0.426	0.474	0.425	0.432
Per Kilo Body Wt.	0.0048	0.0066	0.0058	0.0081	0.0067	0.0072

TABLE 40 Percent of Total Urinary Nitrogen present as Ammonia (16 day periods) Group C.

Period No.	Subj. 2 p.ct.	Subj. 15 p.ct.	Subj. 18 p.ct.	Subj. 21 p.ct.	Subj. 22 p.ct.	Subj. 23 p.ct.
15-18	3.13	---	3.29	---	3.63	---
19-22	---	---	3.31	---	3.77	---
23-26	---	---	3.49	4.28	4.01	5.56
27-30	3.43	3.55	3.51	4.38	---	5.29
31-34	3.49	4.07	3.76	4.38	---	5.20
Av. (80 days)	3.34	3.81	3.44	4.35	3.47	5.35
35-38	3.52	4.80	3.68	4.31	3.64	5.15
39-42	3.51	3.83	3.46	4.44	3.81	5.25
43-46	---	3.97	2.95	4.12	3.60	4.53
47-50	3.09	4.06	3.51	4.42	3.02	4.58
51-54	3.11	3.97	3.17	4.40	3.72	5.13
55-58	3.70	4.13	3.68	4.34	3.71	5.05
Av. (96 days)	3.40	3.41	4.36	3.64	4.45	3.46
59-62	3.36	3.77	4.10	4.51	3.65	4.67
63-66	3.68	3.91	3.30	4.73	4.31	5.19
Av. (32 days)	3.52	3.84	3.70	4.62	3 98	4.93
" (208 "	3.40	3.88	3.47	4.40	3 84	5.11

URINARY NITROGEN.

TABLE 41 Ammonia Nitrogen per 24 hours (6day periods) Group A.

Period No.	Subj. 5 gms.	Subj. 10 gms.	Subj. 11 gms.	Subj. 13 gms.	Subj. 20 gms.	Subj. 24 gms.
15-18	0.374	0.399	0.501	---	---	---
19-22	0.395	---	0.524	---	---	---
23-26	0.365	---	0.458	0.467	0.373	---
27-30	0.350	0.354	0.530	0.446	0.404	0.431
31-34	0.323	0.378	0.418	0.438	0.410	0.450
Av. (30days)	0.351	0.385	0.486	0.451	0.396	0.440
35-38	0.332	0.355	0.414	0.467	0.415	0.442
39-42	0.350	0.371	0.445	0.420	---	0.443
43-46	---	0.400	0.451	0.467	---	0.461
47-50	0.369	0.397	0.502	0.481	---	0.507
51-54	0.308	0.384	0.450	0.445	---	0.516
55-58	0.324	0.382	0.415	0.437	---	0.522
Av. (96days)	0.337	0.379	0.440	0.453	---	0.482
59-62	0.316	0.390	0.401	0.442	---	0.438
63-66	0.304	0.412	0.421	0.444	---	0.546
Av. (32days)	0.310	0.401	0.411	0.445	---	0.492
" (208 ")	0.334	0.385	0.453	0.451	0.394	0.467
Gerrig's Body Wt.	0.0054	0.0050	0.0070	0.0067	0.0063	0.0075

TABLE 42 Percent of Total Urinary Nitrogen present as Ammonia (6day periods) Group A.

Period No.	Subj. 5 p.ct.	Subj. 10 p.ct.	Subj. 11 p.ct.	Subj. 13 p.ct.	Subj. 20 p.ct.	Subj. 24 p.ct.
15-18	3.43	3.50	4.30	---	---	---
19-22	3.33	---	4.47	---	---	---
23-26	3.33	---	4.14	4.06	3.41	---
27-30	3.28	3.34	4.59	3.89	3.73	3.54
31-34	3.02	3.61	4.06	4.07	3.55	3.42
Av. (30days)	3.28	3.50	4.31	4.01	3.74	3.73
35-38	3.04	3.31	4.03	4.25	3.58	3.83
39-42	3.23	3.45	4.22	4.11	---	3.78
43-46	---	3.48	3.79	3.94	---	3.76
47-50	3.13	3.30	4.09	3.94	---	4.12
51-54	2.93	3.22	4.01	3.87	---	3.94
55-58	3.20	3.49	4.00	3.91	---	4.21
Av. (96days)	3.11	3.38	4.03	4.01	---	3.94
59-62	3.34	3.62	3.77	3.81	---	3.78
63-66	3.19	3.82	4.19	4.09	---	4.81
Av. (32days)	3.26	3.72	3.98	3.95	---	4.29
" (208 ")	3.20	3.48	4.13	4.00	3.71	3.91

URINARY NITROGEN.

TABLE 43 Creatinin Nitrogen for 24hours (16day periods) Summary Group a

Period No	Subj. 8 gms.	Subj. 9 gms.	Subj. 12 gms.	Subj. 16 gms.	Subj. 17 gms.	Subj. 19 gms.
15-18	0.657	---	---	---	0.677	0.711
19-22	0.584	---	---	---	0.573	0.617
23-26	0.653	0.628	0.695	0.665	0.775	---
27-30	0.642	0.616	0.666	0.665	0.668	0.680
31-34	0.649	0.666	0.696	0.696	0.673	0.707
Av. (80days)	0.641	0.637	0.686	0.675	0.658	0.688
35-38	0.659	---	0.673	0.674	0.664	0.699
39-42	0.635	0.663	0.672	0.707	---	0.721
43-46	0.618	0.653	0.664	0.648	0.677	0.673
47-50	0.620	0.667	0.640	0.667	0.648	0.684
51-54	0.651	0.686	---	0.665	---	0.723
55-58	0.718	0.709	---	0.748	0.761	0.727
Av. (96days)	0.650	0.676	0.670	0.684	0.691	0.700
59-62	0.735	0.723	0.742	0.743	0.782	0.741
63-66	0.649	0.673	0.647	0.664	0.689	0.631
Av. (32days)	0.692	0.698	0.719	0.706	0.735	0.686
" (208 ")	0.653	0.664	0.684	0.684	0.685	0.693
Per Kilo Body Wt.	0.0095	0.0104	0.0101	0.0108	0.0097	0.0106

TABLE 44 Percent of Total Urinary Nitrogen present as Creatinin (16day periods) Group a

Period No	Subj 8 p.ct.	Subj. 9 p.ct.	Subj. 12 p.ct.	Subj. 16 p.ct.	Subj. 17 p.ct.	Subj. 19 p.ct.
15-18	5.50	---	---	---	5.87	5.23
19-22	4.89	---	---	---	4.78	4.70
23-26	5.38	5.29	5.84	7.45	6.03	---
27-30	5.69	5.55	5.93	7.59	6.25	6.54
31-34	6.12	6.28	6.58	8.54	6.34	7.18
Av. (80days)	5.54	5.70	6.12	7.86	5.86	5.88
35-38	5.98	---	5.87	7.69	6.55	6.40
39-42	5.96	6.85	5.75	7.44	---	6.19
43-46	5.42	6.10	5.52	6.91	6.21	5.92
47-50	5.45	5.64	5.08	6.55	5.71	5.88
51-54	5.53	5.75	---	6.73	---	6.38
55-58	6.41	6.11	---	7.47	6.91	6.93
Av. (96days)	5.79	6.10	5.70	7.10	6.66	6.33
59-62	6.72	6.60	7.25	7.53	8.10	7.81
63-66	6.10	6.24	6.24	7.27	6.76	6.38
Av. (32days)	6.41	6.42	6.74	7.40	7.43	7.09
" (208 ")	5.79	6.00	6.02	7.44	6.47	6.25

URINARY NITROGEN.

TABLE 45 Creatinine Nitrogen for 24 Hours (16 day periods) Group b.

Period No	Subj. 1 gms.	Subj. 3 gms.	Subj. 4 gms.	Subj. 6 gms.	Subj. 7 gms.	Subj. 14 gms.
15-18	- - -	- - -	0.775	0.650	- - -	0.637
19-22	- - -	- - -	0.651	0.577	- - -	0.576
23-26	0.765	0.666	0.755	0.639	0.721	0.619
27-30	0.747	0.657	0.718	0.655	0.713	0.631
31-34	0.782	- - -	0.759	0.666	0.751	0.589
Av. (80 days)	0.765	0.655	0787	0.644	0.728	0.622
35-38	0.762	0.666	0.744	0.666	0.744	0.613
39-42	0.744	0.672	0.774	0.672	0.748	0.597
43-46	0.748	0.678	0.754	0.634	0.716	0.604
47-50	0.766	0.620	0.734	0.622	0.684	0.596
51-54	0.723	0.636	0.752	0.660	0.720	- - -
55-58	0.818	0.738	0.847	0.773	0830	0.628
Av. (96 days)	0760	0.668	0.767	0.671	0.740	0.608
59-62	0.847	0745	0.823	0.736	0 844	0.637
63-66	0.736	0.667	0.768	0.675	0.753	0.581
Av. (32 days)	0792	0.706	0.795	0.705	0.800	0.609
" (208 ")	0.767	0.673	0.763	0.675	0.751	0.610
Per Kilo Body Wt.	0.0108	0.0119	0.0096	0.0096	0.0108	0.0113

TABLE 46 Percent of Total Urinary Nitrogen present as Creatinin (16 day periods) Group b

Period No.	Subj. 1 p.ct.	Subj. 3 p.ct.	Subj. 4 p.ct.	Subj. 6 p.ct.	Subj. 7 p.ct.	Subj. 14 p.ct.
15-18	- - -	- - -	5.51	6.04	- - -	7.54
19-22	- - -	- - -	4.72	5.78	- - -	6.25
23-26	6.47	6.59	5.93	6.78	7.49	6.87
27-30	6.50	6.34	6.14	6.71	8.00	7.35
31-34	6.95	- - -	671	7.26	9.13	6.72
Av. (80 days)	6.64	6.44	5.83	6.48	8.21	7.19
35-38	6.46	6.83	6.02	6.89	8.89	6.89
39-43	6.05	6.39	6.47	6.74	8.11	6.74
43-46	6.12	5.99	6.05	6.59	7.08	6.53
47-50	5.97	5.67	5.48	6.12	6.39	6.72
51-54	6.16	5.71	5.64	6.21	7.12	- - -
55-58	7.49	6.98	6.84	7.82	8.42	8.64
Av. (96 days)	6.38	627	6.08	6.73	7.76	7.11
59-62	8 04	7.32	7.10	7.97	9.34	8.83
63-66	7.14	6.47	6.58	7.21	8.01	8.14
Av. (32 days)	7.59	6.89	6.84	7.59	8.67	8.48
" (208 ")	6.67	6.43	6.10	6.77	8.07	7.35

URINARY NITROGEN.

TABLE 47 Creatinin Nitrogen for 24 Hours (16 day periods) Group C

Period No.	Subj. 2 gms	Subj. 15 gms	Subj. 18 gms.	Subj. 21 gms	Subj. 22 gms	Subj. 23 gms.
15-18	0.858	---	0.730	---	0.658	---
19-22	---	---	0.694	---	0.568	---
23-26	---	---	0.752	0.610	0.662	0.591
27-30	0.824	---	0.795	0.591	---	0.571
31-34	0.859	0.654	0761	0.637	---	0.593
Av. (80 days)	0.837	0.655	0.752	0.612	0.655	0.585
35-38	0.824	0 632	0.778	0.604	0.625	0.579
38-42	0.833	0.670	0.743	0.641	0 608	0 596
43-46	---	0.659	0.745	0.668	0.601	0.578
47-50	0.783	0.656	0.731	0.688	0.622	0.575
51-54	0.808	0.689	0.758	0.595	0.624	0.603
55-58	0 878	0.768	0 871	0.681	0.724	0.635
Av. (96 days)	0823	0.679	0.771	0.647	0.634	0.594
59-62	0.930	0.781	0.898	0 651	0.746	0.638
63-66	0.840	0.706	0.799	0.602	0.684	0.618
Av. (32 days)	0.885	0.743	0.849	0.626	0.715	0 628
" (208 ")	0.838	0.680	0.775	0.631	0.643	0.596
Per Kilo Body Wt.	0.0104	0.0105	0.0106	0.0108	0.0101	0.0107

TABLE 48 Percent of Total Urinary Nitrogen present as Creatinin (16 day periods) Group C

Period No.	Subj. 2 p.c.	Subj. 15 p.c.	Subj. 18 p.c.	Subj. 21 p.c.	Subj. 22 p.c.	Subj. 23 p.c.
15-18	6.71	---	6.01	---	5.15	---
19-22	---	---	5.75	---	4.48	---
23-26	---	---	6.38	4.44	5.83	7.30
27-30	7.72	---	6.85	5.27	---	6.92
31-34	7.75	6.45	7.17	6.18	---	7.04
Av. (80 days)	7.14	6.39	7.07	5.63	6.19	7.11
35-38	7.56	5.94	7.11	5.53	6.29	7.06
39-42	7.60	6.47	6.72	5.98	6.09	7.12
43-46	---	5.69	5.99	5.70	5.42	6.44
47-50	6.70	5.68	5.85	5.89	5.37	6.22
51-54	6.98	6.03	6.37	5.50	5.58	6.81
55-58	7.62	6.95	7.21	6.66	6.40	7.39
Av. (96 days)	7.22	6.13	6.37	5.55	5.86	6.76
59-62	8.04	6.89	8.48	6.95	7.01	7.51
63-66	7.40	6.77	6.96	6.06	5.94	6.68
Av (32 days)	7.72	6.83	7.72	6.50	6.47	7.09
" (208 ")	7.27	6.34	6 85	5.73	6.08	695

URINARY NITROGEN.

TABLE 49 Creatinin Nitrogen for 24 hours. (6day periods) Group a.

Period No.	Subj. 5 gms.	Subj. 10 gms.	Subj. 11 gms.	Subj. 13 gms.	Subj. 20 gms.	Subj. 24 gms.
15-18	0.669	0.700	0.705	---	---	---
19-22	0.578	---	0.619	---	---	---
23-26	0.685	---	0.728	0.742	0.635	---
27-30	0.666	0.679	0.722	0.730	0.607	0.672
31-34	0.680	0.690	0.689	0.743	0.685	0.620
Afr.(80days)	0.660	0.686	0.693	0.743	0.662	0.616
35-38	0.673	0.672	0.680	0.722	0.689	0.671
39-42	0.673	0.660	0.703	0.731	---	0.578
43-46	---	0.678	0.656	0.716	---	0.644
47-50	0.633	0.648	0.695	0.707	---	0.655
51-54	0.638	0.661	0.664	0.720	---	0.651
55-58	0.717	0.754	0.739	0.771	---	0.741
Afr.(96days)	0.666	0.678	0.691	0.670	---	0.666
59-62	0.711	0.770	0.724	0.832	---	0.748
63-66	0.661	0.721	0.663	0.740	---	0.710
Afr.(32days)	0.686	0.745	0.693	0.786	---	0.724
" (208 ")	0.667	0.676	0.692	0.716	0.667	0.656
Per Kilo Body Wt.	0.0115	0.0088	0.107	0.106	0.106	0.112

TABLE 50 Per cent of Total Urinary Nitrogen present as Creatinin (6day periods) Group a.

Period No.	Subj. 5 p.ct.	Subj. 10 p.ct.	Subj. 11 p.ct.	Subj. 13 p.ct.	Subj. 20 p.ct.	Subj. 24 p.ct.
15-18	6.14	6.14	6.05	---	---	---
19-22	4.89	---	5.26	---	---	---
23-26	6.31	---	6.58	6.47	6.64	---
27-30	6.10	6.41	6.30	6.38	6.20	5.01
31-34	6.74	6.54	6.70	6.48	5.92	5.41
Afr.(80days)	6.06	6.25	6.18	6.61	6.26	5.21
35-38	6.16	6.24	6.68	6.57	5.96	5.81
39-42	6.19	6.17	6.68	6.76	---	5.88
43-46	---	5.85	5.52	6.05	---	5.24
47-50	5.39	5.40	5.67	5.86	---	5.37
51-54	6.09	5.55	5.95	6.28	---	4.98
55-58	7.13	6.89	7.12	6.93	---	5.96
Afr.(96days)	6.19	6.02	6.27	6.41	---	5.62
59-62	7.55	7.16	6.80	7.18	---	6.47
63-66	6.95	6.68	7.17	6.74	---	6.27
Afr.(32days)	7.25	6.92	6.98	6.96	---	6.37
" (208 ")	6.30	6.25	6.34	6.57	6.21	5.58

URINARY NITROGEN.

TABLE 51 Uric Acid Nitrogen per 24 hours. (16 day periods) Summary Group a

Period No	Subj. 8 gms.	Subj. 9 gms.	Subj. 12 gms.	Subj. 16 gms.	Subj. 17 gms.	Subj. 19 gms.
15-18	0.225	---	---	---	0.200	0.202
19-22	0.216	---	---	---	0.203	0.196
23-26	0.222	0.183	0.206	0.198	0.202	---
27-30	0.215	0.172	0.205	0.194	0.196	0.201
31-34	0.207	0.172	0.202	0.190	0.200	0.180
Av. (80 days)	0.218	0.176	0.205	0.194	0.198	0.196
35-38	0.214	---	0.202	0.188	0.180	0.192
39-42	0.204	0.167	0.160	0.184	---	0.174
43-46	0.206	0.175	0.189	0.189	0.203	0.197
47-50	0.203	0.179	0.189	0.202	0.209	0.196
51-54	0.207	0.173	---	0.185	---	0.189
55-58	0.206	0.167	---	0.188	0.219	0.191
Av. (96 days)	0.207	0.172	0.165	0.189	0.203	0.190
59-62	0.212	0.163	0.190	0.188	0.200	0.175
63-66	0.208	0.162	0.199	0.192	0.214	0.189
Av. (32 days)	0.210	0.163	0.195	0.190	0.207	0.182
" (208 ")	0.212	0.171	0.185	0.191	0.202	0.191
Per Kilo Body Wt.	0.0031	0.0027	0.0027	0.0030	0.0029	0.0029

TABLE 52 Percent of Total Urinary Nitrogen present as Uric Acid (16 day periods) Group a

Period No	Subj. 8 p.ct.	Subj. 9 p.ct.	Subj. 12 p.ct.	Subj. 16 p.ct.	Subj. 17 p.ct.	Subj. 19 p.ct.
15-18	1.88	---	---	---	1.73	1.48
19-22	1.80	---	---	---	1.69	1.48
23-26	1.90	1.53	1.73	2.22	1.80	---
27-30	1.90	1.53	1.82	2.21	1.83	1.93
31-34	1.94	1.62	1.87	2.33	1.81	1.82
Av. (80 days)	1.89	1.56	1.81	2.25	1.76	1.66
35-38	1.93	---	1.75	2.15	1.77	1.76
39-42	1.91	1.72	1.37	1.95	---	1.50
43-46	1.81	1.62	1.57	2.01	1.87	1.74
47-50	1.78	1.52	1.50	1.97	1.84	1.68
51-54	1.76	1.45	---	1.86	---	1.73
55-58	1.84	1.44	---	1.88	1.99	1.81
Av. (96 days)	1.84	1.55	1.41	1.97	1.87	1.70
59-62	1.94	1.48	1.85	1.90	1.91	1.85
63-66	1.95	1.49	1.85	2.08	2.10	1.91
Av. (32 days)	1.94	1.48	1.85	1.99	2.00	1.88
" (208 ")	1.87	1.54	1.63	2.08	1.85	1.71

URINARY NITROGEN

TABLE 53 Uric Acid Nitrogen per 24 Hours. (16 day periods) Group b.

Period No.	Subj. 1 gms.	Subj. 3 gms.	Subj. 4 gms.	Subj. 6 gms.	Subj. 7 gms.	Subj. 14 gms.
15-18	---	---	0.225	0.186	---	0.166
19-22	---	---	0.227	0.177	---	0.155
23-26	0.196	0.176	0.218	0.177	0.203	0.147
27-30	0.201	0.174	0.238	0.202	0.192	0.145
31-34	0.197	---	0.217	0.176	0.175	0.141
Av. (80 days)	0.198	0.175	0.226	0.185	0.190	0.152
35-38	0.203	0.167	0.230	0.166	0.181	0.138
39-42	0.185	0.173	0.219	0.194	0.179	0.141
43-46	0.178	0.188	0.236	0.173	0.183	0.137
47-50	0.200	0.171	0.240	0.189	0 196	0.137
51-54	0.180	0.176	0.231	0.187	0.187	---
55-58	0.186	0.185	0.230	0.183	0.194	0.111
Av. (96 days)	0.188	0.177	0.231	0.182	0.187	0.133
59-62	0.187	0.172	0.232	0.183	0.185	0.103
63-66	0.177	0.161	0.229	0.180	0.188	0.108
Av. (32 days)	0.182	0.167	0.231	0.181	0.187	0.106
" (208 ")	0.191	0.175	0.229	0.183	0.188	0.136
Per Kilo Body Wt.	0.0027	0.0032	0.0029	0.0026	0.0027	0.0025

TABLE 54 Percent of Total Urinary Nitrogen present as Uric Acid (16 day periods) Group b

Period No.	Subj. 1 p.ct.	Subj. 3 p.ct.	Subj. 4 p.ct.	Subj. 6 p.ct.	Subj. 7 p.ct.	Subj. 14 p.ct.
15-18	---	---	1.60	1.71	---	1.97
19-22	---	---	1.63	1.77	---	1.68
23-26	1.66	1.74	1.71	1.88	2.13	1.64
27-30	1.75	1.67	2.03	2.06	2.15	1.70
31-34	1.75	---	1.91	1.91	2.13	1.60
Av. (80 days)	1.72	1.73	1.78	1.83	2.14	1.75
35-38	1.72	1.70	1.73	1.82	2.17	1.54
39-42	1.50	1.65	1.82	1.93	1.93	1.59
43-46	1.45	1.80	1.89	1.80	1.81	1.48
47-50	1.55	1.56	1.78	1.86	1.83	1.53
51-54	1.53	1.58	1.73	1.75	1.86	---
55-58	1.69	1.75	1.85	1.84	1.95	1.53
Av. (96 days)	1.58	1.68	1.80	1.84	1.92	1.55
59-62	1.77	1.69	2.00	1.98	2.05	1.43
63-66	1.71	1.68	1.96	1.92	1.99	1.50
Av. (32 days)	1.74	1.68	1.98	1.95	2.02	1.46
" (208 ")	1.66	1.70	1.82	1.85	2.02	1.61

URINARY NITROGEN.

TABLE 55 Uric Acid Nitrogen for 24 Hours. (16day periods) Group C.

Period No.	Subj. 2 gms.	Subj. 15 gms.	Subj. 18 gms.	Subj. 21 gms.	Subj. 22 gms.	Subj. 23 gms.
15-18	0.203	---	0.186	---	0.194	---
19-22	---	---	0.190	---	0.198	---
23-26	---	0.233	0.192	0.184	0.189	0.160
27-30	0.210	0.229	0.181	0.177	---	0.163
31-34	0.205	0.225	0.178	0.181	---	0.156
Av.(80days)	0.207	0.217	0.185	0.181	0.196	0.159
35-38	0.196	0.240	0.179	0.186	0.172	0.157
39-42	0.191	0.207	0.166	0.174	0.162	0.155
43-46	---	0.234	0.179	0.188	0.172	0.160
47-50	0.200	0.219	0.178	0.190	0.176	0.159
51-54	0.192	0.222	0.173	0.177	0.177	0.160
55-58	0.196	0.269	0.181	0.175	0.201	0.161
Av.(96days)	0.195	0.232	0.176	0.182	0.177	0.159
59-62	0.209	0.261	0.186	0.170	0.179	0.151
63-66	0.199	0.250	0.182	0.164	0.195	0.150
Av.(32days)	0.204	0.255	0.184	0.169	0.187	0.150
" (208 ")	0.201	0.229	0.181	0.180	0.186	0.158
Per Kilo Body Wt.	0.0025	0.0034	0.0025	0.0031	0.0029	0.0028

TABLE 56 Percent of Total Urinary Nitrogen present as Uric Acid. (16day periods) Group C.

Period No.	Subj. 2 p.ct.	Subj. 15 p.ct.	Subj. 18 p.ct.	Subj. 21 p.ct.	Subj. 22 p.ct.	Subj. 23 p.ct.
15-18	1.58	---	1.53	---	1.52	---
19-22	---	---	1.58	---	1.56	---
23-26	---	---	1.63	1.60	1.67	1.47
27-30	1.96	2.10	1.55	1.58	---	1.97
31-34	1.90	2.19	1.67	1.76	---	1.85
Av.(80days)	1.77	2.15	1.59	1.65	1.64	1.93
35-38	1.78	2.25	1.63	1.68	1.72	1.91
39-42	1.74	2.08	1.49	1.62	1.62	1.85
43-46	---	2.02	1.44	1.60	1.55	1.78
47-50	1.70	1.89	1.42	1.65	1.51	1.72
51-54	1.65	1.94	1.45	1.63	1.58	1.80
55-58	1.70	2.43	1.49	1.70	1.76	1.86
Av.(96days)	1.70	2.12	1.49	1.65	1.63	1.82
59-62	1.81	2.30	1.75	1.77	1.69	1.81
63-66	1.75	2.22	1.56	1.69	1.82	1.76
Av.(32days)	1.78	2.26	1.65	1.73	1.75	1.78
" (208 ")	1.74	2.15	1.55	1.66	1.65	1.86

URINARY NITROGEN

TABLE 57 Uric Acid Nitrogen for 24 hours (16day periods) Group C.

Period	Subj. 5 gms.	Subj. 10 gms.	Subj. 11 gms.	Subj. 13 gms.	Subj. 20 gms.	Subj. 24 gms.
15-18	0.160	0.170	0.203	- - -	- - -	- - -
19-22	0.178	- - -	0 212	- - -	- - -	- - -
23-26	0.173	- - -	0.211	0.213	0.220	- - -
27-30	0.157	0.167	0.232	0 204	0.232	0.144
31-34	0.158	0.171	0.198	0.199	0.233	0.149
Av.(80days)	0.164	0.171	0.210	0.205	0.229	0.147
35-38	0.159	0.197	0.195	0.206	0.235	0.148
39-42	0.165	0.173	0.193	0.188	- - -	0.145
43-46	- - -	0.176	0.202	0.200	- - -	0.151
47-50	0.167	0.170	0.200	0 203	- - -	0.152
51-54	0.154	0.185	0.187	0.196	- - -	0.150
55-58	0.150	0.184	0178	0 205	- - -	0.156
Av.(96days)	0.160	0.181	0.192	0.200	- - -	0.151
59-62	0.161	0.180	0.189	0.201	- - -	0.156
63-66	0.142	0.174	0.183	0.194	- - -	0.152
Av.(32days)	0.152	0.177	0.186	0.200	- - -	0.154
" (208 ")	0.160	0177	0.198	0.202	0.230	0.150
Per Kilo Body Wt.	0.0028	0.0023	0.0031	0.0030	0.0037	0.0024

TABLE 58 Percent of Total Urinary Nitrogen present as Uric Acid (16day periods) Group d.

Period.	Subj 5 p.ct.	Subj. 10 p.ct.	Subj. 11 p.ct.	Subj. 13 p.ct.	Subj. 20 p.ct.	Subj 24 p.ct.
15-18	1.47	1.49	1.74	- - -	- - -	- - -
19-22	1.50	- - -	1.81	- - -	- - -	- - -
23-26	1.58	- - -	1.90	1.85	2.30	- - -
27-30	1.46	1.57	2 02	1 78	2.16	1.16
31-34	1.62	1.63	1.92	1.85	2 01	1.30
Av.(80days)	1.52	1.55	1.86	1.83	2.16	1.23
35-38	1.45	1.83	1.89	1 88	2.02	1.28
39-42	1.52	1.62	1.83	1.74	- - -	1.24
43-46	- - -	1.53	1.69	1.69	- - -	1.23
47-50	1.41	1.42	1.63	1.68	- - -	1.24
51-54	1.46	1.55	1.67	1.73	- - -	1 18
55-58	1.49	1.68	1.71	1 84	- - -	1.25
Av.(96days)	1.48	1.61	1.74	1.76	- - -	1 24
59-62	1.71	1.66	1.81	1.78	- - -	1.34
63-66	1.50	1.60	1.81	1.77	- - -	1.33
Av.(32days)	1.60	1.63	1.81	1.77	- - -	1.33
" (208 ")	1.51	1.54	1.80	1.79	2.14	1.25

URINARY NITROGEN.

TABLE 59 Undetermined Nitrogen per 24 hours (16day periods) Summary Group a.

Period No.	Subj. 8 gms.	Subj 9 gms.	Subj. 12 gms.	Subj 16 gms.	Subj. 17 gms.	Subj. 19 gms.
15-18	0.671	---	---	---	0.834	0.651
19-22	0.681	---	---	---	0.544	0.818
23-26	0.690	0.009	0.248	0.350	0.745	---
27-30	0.578	-0.230	-0.105	---	0.570	0.509
31-34	0.699	---	0.132	0.172	0.678	0.192
Avr.(80days)	0.652	-0.167	0.123	0.237	0.646	0.465
35-38	0.459	---	0.478	0.281	0.381	0.063
39-42	0.451	0.180	1.015	0.593	---	0.516
43-46	0.492	---	0.314	0.306	0.344	0.189
47-50	0.585	0.572	0.366	0.611	0.615	---
51-54	0.676	0.596	---	0.363	---	0.584
55-58	0.691	0.245	---	0.500	0.362	0.403
Avr.(96days)	0.559	0.342	0.482	0.443	0.443	0.360
59-62	0.551	0.397	0.691	0.564	0.319	0.457
63-66	0.506	0.498	0.470	0.695	0.513	0.364
Avr.(32days)	0.529	0.448	0.580	0.629	0.416	0.411
" (208 ")	0.590	0.163	0.359	0.392	0.517	0.408
Perkilo Body wt.	0.0086	0.0026	0.0053	0.0062	0.0072	0.0063

TABLE 60 Percent of Total Urinary Nitrogen present as Undetermined Nitrogen (16day periods) Group a

Period No	Subj 8 p.ct.	Subj 9 p.ct.	Subj. 12 p.ct	Subj. 16 p.ct.	Subj. 17 p.ct.	Subj. 19 p.ct.
15-18	5.74	---	---	---	7.23	4.87
19-22	4.60	---	---	---	6.29	6.22
23-26	5.90	0.09	2.06	3.87	6.61	---
27-30	5.04	-2.08	-0.09	---	5.42	491
31-34	6.60	---	1.20	2.85	6.24	1.92
Avr.(80days)	5.51	-0.16	1.06	2.98	6.04	4.20
35-38	4.24	---	4.10	2.99	3.74	0.55
39-42	4.22	1.83	8.70	6.28	---	4.44
43-46	4.33	---	2.37	3.31	3.82	1.67
47-50	5.09	4.79	2.91	5.92	5.48	---
51-54	5.80	5.05	---	3.74	---	4.64
55-58	6.21	2.09	---	5.02	3.25	3.85
Avr.(96days)	4.99	2.97	4.06	4.55	4.15	3.10
59-62	4.99	3.59	6.64	5.69	3.52	4.65
63-66	4.78	4.72	4.34	7.59	5.01	3.69
Avr.(32days)	4.88	4.15	5.49	6.64	4.26	4.01
" (208 ")	5.17	1.95	3.13	4.27	4.89	3.66

URINARY NITROGEN.

TABLE 61 Undetermined Nitrogen for 24 Hours. (16day periods) Group D.

Period No.	Subj. 1 gms.	Subj. 3 gms.	Subj. 4 gms.	Subj. 6 gms.	Subj. 7 gms.	Subj. 14 gms.
15-18	---	---	0.446	---	---	0.714
19-22	---	---	0.728	0.414	---	0.701
23-26	0.570	0.076	0.706	0.389	0.203	0.474
27-30	0.634	-0.044	0.373	0.364	-0.073	0.437
31-34	0.429	---	0.535	0.163	0.063	0.266
Av.(80days)	0.586	-0.049	0.589	0.385	0.064	0.490
35-38	0.564	0.063	0.409	0.367	0.176	0.257
39-42	0.272	0.506	0.385	0.451	0.561	0.379
43-46	0.587	0.384	0.416	0.506	0.616	0.315
47-50	0.767	0.753	0.608	0.741	0.506	0.545
51-54	0.703	0.534	0.310	0.568	0.717	---
55-58	0.459	0.290	0.435	0.461	0.522	0.141
Av.(96days)	0.558	0.422	0.423	0.503	0.516	0.311
59-62	0.680	0.326	0.511	0.472	0.404	0.299
63-66	---	0.500	0.529	0.637	0.425	0.479
Av.(32days)	0.668	0.413	0.520	0.555	0.414	0.389
" (208 ")	0.586	0.239	0.502	0.466	0.326	0.392
Per Kilo Body Wt.	0.0083	0.0042	0.0063	0.0067	0.0047	0.0073

TABLE 62 Per cent of Total Urinary Nitrogen present as Undetermined Nitrogen (16day periods) Group D.

Period-No.	Subj. 1 p.ct.	Subj. 3 p.ct.	Subj. 4 p.ct.	Subj. 6 p.ct.	Subj. 7 p.ct.	Subj. 14 p.ct.
15-18	---	---	3.23	---	---	3.29
19-22	---	---	5.26	4.16	---	7.61
23-26	4.89	0.73	5.56	4.11	2.06	5.15
27-30	5.53	-0.44	3.21	3.71	-0.78	5.13
31-34	3.74	---	4.74	1.76	0.68	2.99
Av.(80days)	4.72	-0.52	4.62	3.79	0.74	4.68
35-38	4.75	0.59	2.33	3.83	2.00	2.91
39-42	2.18	4.81	3.19	4.41	6.09	4.27
43-46	4.82	3.57	3.33	5.33	6.11	3.45
47-50	5.95	6.89	4.47	7.26	5.82	6.16
51-54	5.90	4.79	2.36	5.39	7.16	---
55-58	4.21	2.73	3.56	4.69	5.24	3.03
Av.(96days)	4.64	3.90	3.38	4.83	5.41	3.84
59-62	6.46	3.19	4.38	5.14	4.46	4.25
63-66	---	5.18	4.55	6.79	4.50	6.80
Av.(32days)	6.37	4.18	4.46	5.96	4.48	5.52
" (208 ")	4.84	2.37	4.02	4.60	3.49	4.47

URINARY NITROGEN.

TABLE 63 Undetermined Nitrogen for 24 Hours. (4 day periods) Group C.

Period No.	Subj. 2 gms.	Subj. 15 gms.	Subj. 18 gms.	Subj. 21 gms.	Subj. 22 gms.	Subj 23 gms.
15-18	0.724	- - -	0.505	- - -	0.814	- - -
19-22	- - -	- - -	0.430	- - -	0.732	- - -
23-26	- - -	- - -	0.532	0.223	0.733	0.137
27-30	0.522	- - -	0.419	0.208	- - -	0.161
31-34	0.614	-0.130	0.353	0.313	- - -	0.144
Av. (80 days)	0.625	- 0.152	0.482	0.248	0.698	0.148
35-38	0.340	0.243	0.343	0.230	0.341	0.271
39-42	0.270	0.548	0.785	0.365	0.094	0.517
43-46	- - -	0.634	0.566	0.089	0.532	0.238
47-50	- - -	0.581	0.545	0.496	0.370	0.577
51-54	0.522	0.746	0.806	0.498	0.524	0.467
55-58	0.529	0.473	0.619	0.240	0.520	0.369
Av. (96 days)	0.406	0.538	0.603	0.320	0397	0.407
59-62	0.452	0.688	0.501	0.321	0.540	0.336
63-66	0.454	0.511	0.457	0.528	0.599	0.518
Av. (32 days)	0.453	0.599	0.479	0.425	0.569	0.427
" (208 ")	0.497	0.282	0.537	0.308	0.539	0.310
Per Kilo Body Wt.	0.0062	0.0044	0.0073	0.0053	0.0085	0.0056

TABLE 64 Percent of Total Urinary Nitrogen present as Undetermined Nitrogen. (4 day periods) Group C.

Period No.	Subj. 2 p.ct.	Subj. 15 p.ct.	Subj. 18 p.ct.	Subj. 21 p.ct.	Subj. 22 p.ct.	Subj. 23 p.ct.
15-18	5.62	- - -	4.23	- - -	6.40	- - -
19-22	- - -	- - -	3.63	- - -	5.80	- - -
23-26	- - -	- - -	4.15	1.97	6.46	1.69
27-30	4.87	- - -	3.69	1.84	- - -	1.92
31-34	5.66	0.05	3.29	3.24	- - -	1.71
Av. (80 days)	5.37	- 0.61	3.95	2.35	5.83	1.78
35-38	3.06	2.27	3.15	2.07	5.15	3.27
39-42	2.27	5.28	6.64	3.44	0.95	6.12
43-46	- - -	5.69	4.55	0.75	4.85	2.65
47-50	- - -	5.06	4.33	4.36	3.16	6.24
51-54	4.51	6.53	6.76	4.69	4.67	5.67
55-58	4.62	4.27	5.09	2.27	7.56	4.29
Av. (96 days)	3.52	4.44	5.09	2.93	3.90	4.71
59-62	3.95	6.10	4.75	3.32	5.07	4.01
63-66	3.97	4.53	4.05	5.30	5.53	6.14
Av. (32 days)	3.96	5.31	4.40	4.31	5.18	5.07
" (208 ")	4.30	2.63	4.55	3.00	4.84	3.04

URINARY NITROGEN

TABLE 65 Undetermined Nitrogen for 24 Hours (6day periods) Group C.

Period.	Subj. 5 gms	Subj 10 gms	Subj. 11 gms.	Subj. 13 gms.	Subj. 20 gms	Subj. 24 gms.
15-18	0.518	0814	0.741	- - -	- - -	- - -
19-22	0.491	- - -	0.526	- - -	- - -	- - -
23-26	0.620	- - -	0.741	0.539	0.134	- - -
27-30	0.709	0.687	0.535	0.194	0.235	- - -
31-34	0.446	0.484	0.490	0.175	−0.056	−0.051
Afr.(8days)	0.557	0676	0.625	0.303	0.107	0064
35-38	0.570	0.466	0.639	0.241	0.124	0.288
39-42	0.445	0.539	0.502	0.670	- - -	0587
43-46	- - -	0.377	0.230	0.610	- - -	0.392
47-50	0.460	0.698	0.513	0.903	- - -	0.772
51-54	0.546	0674	0.513	0.556	- - -	0.726
55-58	0.326	0.630	0.637	0.549	- - -	0.214
Afr.(96days)	0.437	0.552	0.510	0.588	- - -	0.497
59-62	0.562	0.585	0.567	0.599	- - -	0.512
63-66	0.328	0.385	- - -	0.681	- - -	0.447
Afr.(32days)	0445	0.485	0.544	0640	- - -	0.479
" (208 ")	0.484	0.589	0.559	0486	0.108	0.328
Per Kilo Body Wt	0.0084	0.0076	0.0086	0.0072	0.0017	0.0053

TABLE 66 Percent of Total Urinary Nitrogen present as Undetermined Nitrogen (6day periods) Group C.

Period.	Subj. 5 gms.	Subj. 10 gms.	Subj. 11 gms	Subj. 13 gms.	Subj. 20 gms	Subj. 24 gms.
15-18	5.52	7.17	6.35	- - -	- - -	- - -
19-22	4.19	- - -	4.45	- - -	- - -	- - -
23-26	5.62	- - -	6.64	4.68	1.38	- - -
27-30	6.62	6.49	4.70	1.65	2.23	- - -
31-34	4.13	4.63	4.72	1.55	−0.51	−0.47
Afr.(8days)	5.24	6.12	5.51	2.63	1.04	−0.55
35-38	5.39	4.51	6.57	2.11	1.36	2.41
39-42	4.24	5.05	4.86	6.23	- - -	5.02
43-46	- - -	3.35	2.34	5.15	- - -	3.23
47-50	3.93	5.19	2.56	7.46	- - -	5.70
51-54	5.12	6.04	4.57	4.82	- - -	5.51
55-58	3.27	5.57	6.13	4.99	- - -	2.35
Afr.(96days)	4.30	4.96	4.70	5.13	- - -	4.04
59-62	6.04	5.39	5.47	5.13	- - -	4.42
63-66	3.63	3.56	- - -	6.23	- - -	3.91
Afr.(32days)	4.83	4.47	5.56	5.68	- - -	4.16
" (208 ")	4.74	5.34	5.14	4.25	1.09	2.29

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